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IN THEIR APPLICATION TO

ENGINEERING AND MANUFACTURES.

EDITED BY

JAMES H. GARDINER, F.Inst.P., F.C.S.

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THE CHEMICAL NEWS.

VOLUME CXXIV.

EDITED BY JAMES H. GARDINER, F. Inst. P., F.C.S.

No. 3221.—JANUARY 6, 1922.

THE CHEMICAL NEWS, VOL. CXXIV., No. 3221.

EDITORIAL.

The Editor takes this opportunity of wishing the Readers and Contributors of **THE CHEMICAL NEWS** a very happy and prosperous New Year. The custom is a very old one and unfortunately, during the past few years, has been attended with not a little misgiving as to its fulfilment. But there are now many indications of brighter times ahead. The clouds of the past show signs of breaking, and here and there a gleam of sunshine gives promise of brighter things in the near future.

The War is over and the expected aftermath is developing into a decided determination for earnest work.

The writer, who for many years has been connected with **THE CHEMICAL NEWS** is anxious that the publication shall continue on the lines laid down by its founder, the late Sir William Crookes.

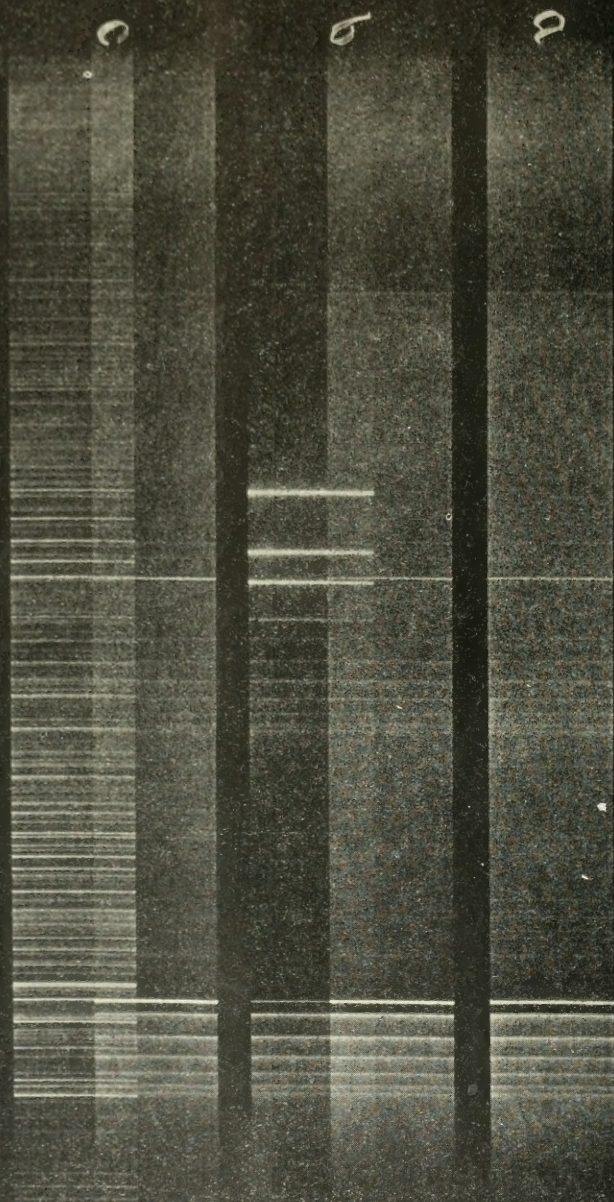
To Sir William, **THE CHEMICAL NEWS** was a constant source of pleasure, and for all the years the writer can remember, the work of its arrangement occupied the last few hours of the day. When the labour of the laboratory, the official and other duties of the day were over, from 9 p.m., to midnight was devoted mostly

to the "News". Sir William was anxious to get into its pages the first announcements of any advance in Chemical or Physical knowledge, and to endeavour that every issue should contain something new and valuable; whether the announcement of an epoch-making discovery or some little laboratory dodge to add to the efficiency of a chemical operation.

The present Editor, whose association with Sir William is tolerably well known, was entrusted by him with the work only when strength failed, and he is very anxious to maintain the character of the paper in accordance with the wishes of the Founder: to that end he counts upon the support and criticism of all workers in the world of science.

Original papers and papers communicated to Societies or Institutions of which an immediate notice or abstract is desirable are welcomed. New and select methods of Chemical Analysis and new devices for time saving or greater efficiency in the laboratory will receive prompt attention; but controversial matter or adverse criticism of other men's labour will be discouraged.

Working on these lines the Editor looks confidently to the coming year with the assurance that the pages of **THE CHEMICAL NEWS** will play a useful part in the continued advancement of that branch of activity that has been aptly termed "Organised Common Sense".



4686.1
↓

4726.7
↓

GERMANIUM II.

THE IDENTIFICATION OF GERMANIUM BY ITS
VISIBLE ARC SPECTRUM.¹

BY JACOB PAPISH.

HISTORICAL.

Rowland and Tatnall² obtained the arc spectrum of germanium from argyrodite by means of a grating spectroscope. They examined the region between λ 2300 and λ 4600, and by eliminating the lines due to known substances that were present in the argyrodite, they measured the wave-lengths and determined the intensity and character of twenty-six germanium lines. Of this number only one line, λ 4266.724 is in the visible region of the spectrum, all others being in the ultra-violet. This line is so close to a prominent calcium line (λ 4226.870) that the two overlap and appear coincident when examined through an instrument of average dispersion.

Exner and Haschek³ measured the arc spectrum of germanium with the aid of a grating spectrograph. Their germanium material consisted of a solution obtained by treating metallic germanium with aqua regia; the metal, in turn, was procured from Clemens Winkler. They call attention to the fact that the visible line, λ 4226.724 is obscured by the very strong line of calcium.

Eder and Valenta⁴ extended the visible arc spectrum of germanium by determining the wave-length of a line in the blue, λ 4686. Judging from their map, this line is rather faint, but when a prism spectroscope or spectrograph is used, the line is intense, sharp, and very suitable for the identification of germanium.

EXPERIMENTAL.

In a previous article⁵ reference has been made to arc spectrographic tests as a means of identifying germanium and of testing the purity of various compounds of germanium. These tests were carried out with the aid of a Hilger constant deviation spectrograph fitted with a flint-glass prism of refractive index $n = 1.7537$. The instrument is sensitive to a wave-length range between λ 8127 and λ 3944 provided suitable

plates are employed for the various regions of the spectrum. Wratten and Wainwright Panchromatic plates were used for the red-green region and Seed 30 Gilt Edge plates for the blue-violet region. Standard Orthonon and Seed's Non-Halation L Ortho plates were also found very suitable.⁶ "Rytol" developer, manufactured by Burroughs, Wellcome and Company, and an acid (acetic) fixing bath were used for developing and fixing the negatives.

The arc was made between carbon or graphite electrodes. The lower electrode carried the material to be tested, and was made the positive pole. Currents of 7 to 10 amperes were usually used. Whenever it was desired to eliminate faint lines due to traces of impurities, larger currents (20 to 25 amperes) were employed. Exposures were usually of two to three seconds' duration; to bring out faint lines, the time was increased to five, eight, and even ten seconds.

The wave-length of the germanium line mentioned by Eder and Valenta (Fig. 1, a) was checked by obtaining a spectrogram of a mixture of the oxides of germanium and zinc (Fig. 1, b) and computing the value with the aid of Hartmann's interpolation formula.⁷ As a further check, the spectrogram of germanium was superposed upon that of zirconium and as seen from Fig. 1, c, the blue germanium line overlaps the prominent zirconium line of wave-length 4688. A comparison was next made of the visible arc and spark spectra of germanium and it was noticed that this line is in the same position as the spark line λ 4686.1, which has been observed by Exner and Haschek.⁸

SUMMARY.

1. A review of the literature on the arc spectrum of germanium is given.
2. A blue germanium arc line, λ 4686, is mentioned as suitable for the identification of germanium.
3. A method for obtaining arc spectrograms is described.

⁶ All of these plates were obtained from the Eastman Kodak Company, Rochester, N.Y.

⁷ *Astrophys. Jour.* 8, 218 (1898).

⁸ *Wellenlängen - Tabellen f. spektralanalytische Untersuchungen auf Grund d. ultravioletten Funkenspektren d. Elemente*, 11, p. 65, Leipzig u. Wien, 1902.

¹ This article is based upon a part of the thesis presented to the Faculty of the Graduate School of Cornell University by Jacob Papish in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

² *Astrophys. Jour.*, 1, 149 (1895).

³ *Wellenlängen-Tabellen f. spektralanalytische Untersuchungen auf Grund der ultravioletten Bogenspektren der Elemente*. Leipzig u. Wien, 1904.

⁴ *Atlas typischer Spektren*, Wien, 1911, p. 37.

⁵ Dennis and Papish. *This Journal* ———.

Line Entities and Line Domains.

PART II.

NOTES.

1. It must be understood that these are matters pressed to the limit of human comprehension, for one cannot state what an electron is made of, or what atomic nuclei are made of without stating what lines of force or line domains are made of. The answer is: *We do not know*. Of course, we do know the electrical properties answering to, or associated with, these conceptions, but beyond that we know nothing.

2. The quantum theory involves a discontinuity somewhere in the mechanism of radiation. In my "Atomic Theories," p. 55, it is summed up thus:—"Consequently the energy has to be 'bunched up,' or emitted spasmodically to maintain the equilibrium principle, and this leads to the discontinuity involved in the quantum theory." It now the line-domains form the mechanism of vibration, these taken as radial units could not vibrate as one compact assemblage of such units if their domains, as in the atom, would give them a rigidity which would preclude a homogeneous type of vibration throughout a given equipotential surface. Consequently one would have to cast about for some mechanism which would fulfill the conditions of

(i.) *general homogeneity* and

(ii.) *particular discontinuity*,

still involving the line-domain conception. The problem at the start seems to be—given a spherical surface, to find out how it can vibrate without either expanding or contracting: the vibration being confined to an equipotential "plane." It seems necessary to partition the surface into areas, and in the centre of each area provide an actuating point. This structure is precisely the equipotential surface of a system of radial line-domains, the central point corresponding to a section of a line of force. So far, so good, but where is the "particular discontinuity" to be located? Is it the partitionment of the domains, or is it the independence of the vibrating central unit lines? In either case, there does not appear to be any particular discontinuity involved unless there is a blocking out of some domains, which amounts to the "bunching up" of the radiations. In such a case one

would expect the origins of the active domains or their lines not to be homogeneous, but to start from various scattered points, as if the vibrations of certain domains prevented others from functioning as transmitters of radiant energy. In other words, the maximum number of the radial line-domains cannot all come into vibration at once, as they would interfere with one another; therefore, as they pick up the vibration one after the other, or some simultaneously, they would soon occupy the spherical space so that no more can take up the vibration. In short, the vibration causes the domains to occupy a larger volume to the exclusion of others as vibrating units, which is tantamount to the "blocking out" mentioned above.

3. Accepting the line-domain idea, it will be seen that their number need not be great enough to begin to approximate to the condition of an aether with a fine-grained molecular structure; consequently, the principle of equipartition of energy need not be violated, for it could not then be said that there was any occasion to consider all the energy ultimately residing in the small molecules. Thus Newton's laws would in this respect be sustained, for the line-domains do not correspond in any way with a large number of small vibrating molecules having a great many degrees of freedom; or an infinite number of degrees of freedom. They correspond in one sense almost to the reverse of this idea. Each line-domain has an entity characteristic, but their number need not be so very great.

4. Those who have been studying the theory of Relativity will have noticed the fundamental rôle played by the *velocity of light* without perhaps realising fully what the words imply. Some think in figures or symbols, some think mechanically, *i.e.*, in terms of mechanism. The latter method has its advantage if it is not pressed too far—as it is pictorial. In order to illustrate what is meant by the velocity of light the mechanical model method will be here developed, especially since it harmonises well with the line ideas of this paper. In this model method the magnitudes employed will be out of all proportion to anything one could practically represent in a model, but this need not matter, for it is

the principle of the argument that stands, whatever be the units or distances taken.

Referring to Fig. 1, W is a very long straight wire. Since the anchorage of the wire at each end does not enter into the problem, as here discussed, this mechanical feature may be eliminated from consideration. S is a long shaft, parallel to the wire, mounted in suitable bearings (not shown) and driven at a uniform speed of one revolution every four seconds. P is a small pointed arm attached to the shaft and adjusted so that once in every revolution it will engage momentarily with the wire and set it in vibration so that a wave of definite speed, wave-length and amplitude will proceed along the wire in both directions from the point of momentary contact C. At a definite distance of 186,000 units a disc D is clamped to the shaft. In reality the distance is in miles, but in this model a smaller unit would seem more convenient. It makes no difference, however, as it is only the proportionate quantities that are to be considered, so that

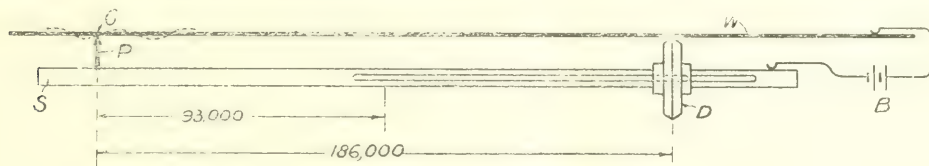


FIG 1.

miles will be retained. On the side of the disc a radial mark M is engraved in a position in sighted line with the central axis of the arm P, see Fig. 2. Now the shaft is connected to one pole of a source of current supply, a few batteries B, whilst the wire W is connected to the other pole, thus completing the circuit, as the edge of the metal disc D is supposed just to touch the wire. When a wave travels along the wire, the moment the wave reaches the disc it causes the wire to break contact. A tiny arc is formed and the edge of the disc is pitted just at the moment the arc takes place. Now if the line M had moved through an angle of 90 degrees when the spark occurred, it would have indicated a lapse of *one second* as the speed of rotation of the shaft is one complete turn in four seconds. It could be said that the wave or undulation travelling along the wire took one second to cover the distance 186,000. This being miles, the velocity was this number of miles per second, which is the velocity of light in free space; hence,

by this model the velocity of light may be illustrated, but it is desirable to consider other variations. Suppose now that the observer or operator grasps the disc D loosely in his hand and runs very quickly towards P with it. He would, of course, start on the run just when the wire is plucked at C. The disc would have to be keyed loosely to the shaft so as to be free to slide lengthwise. Mechanically, a long key-seat would be cut and a key fixed in a key-way cut in the disc. If, to take a simplifying figure, the operator (runner) moves with the velocity of light towards P he would meet the light wave half way, and the pit on the disc will indicate that the shaft has turned through an angle of 45 degrees, this representing half a second. As velocity equals distance travelled divided by the time taken in the journey, $93,000/0.5 = 186,000$, which is the velocity of light as before. So that if one rushes to meet the oncoming wave, just started, as by the model of Fig. 1, it is found that the light is moving with the same velocity as

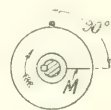


FIG 2.

when the observer was stationary and simply noted the advance of the disc up to the time of the spark, which registers the angular displacement: being the clock in effect.

Suppose one now runs away from the oncoming wave, would the light velocity still be the same by the measurement afforded by the mechanical model? To carry into effect this experiment, that is to say to carry it out in principle, the runner would have to be given a *handicap*, by starting him off with the disc D in, say, a midway place H. By the time the light-wave had reached H (93,000 miles distant from P) he would have travelled a distance of H/2 (46,500 miles) if his velocity is just half that of light; and by the time the light-wave had reached the place corresponding to H/2 he would have moved on to a place represented by 46,500/2; and so on. Now if all these diminishing distances, 93,000; 46,500; 23,250; 11,625; etc., be added, this is the distance covered by the runner up to the time his disc becomes pitted with a

spark, plus his handicap, that is to say, when the light overtakes him. In a similar way the times have to be added thus:—

$\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$ sec., etc., and these have to be divided into the distance covered by the runner up to the moment of the spark, to get the answer which will be the velocity of the light; for this is the whole distance travelled divided by the time taken in the journey, so that—

$$\frac{161,000 + 40,000 + 23,250 + 11,625}{\frac{1}{4}} = 186,000$$

miles per second, and therefore the light velocity is the same. By the method of this model, though the runner (operator or observer) is "running away" from it.

According to this model the light velocity is always the same whatever movement the operator takes. The possibilities of the model are not yet exhausted. Suppose now that the whole apparatus except the wire itself were moving in directions parallel to the axis of the wire and at a high speed in each case. This would make no difference either, because, so far as the wave itself was concerned it would be the same, that is to say, the measurements of velocity would be the same in effect as the last two cases just cited.

The Doppler effect, however, has to be considered. If the operator with the disc is rushing towards P he would meet more wave-crests per unit of time than would apparently pass him if he were stationary, consequently he would observe shorter waves, which is the Doppler effect. There would be more pittings in the circumference of his disc.

If he was now moving away from P he would cross fewer crests per unit of time. If now the whole apparatus except the wire were moving from left to right, then the observer moving with the apparatus would expect to find shorter waves generated in the wire by the type of mechanism illustrated, but as these would be passed less quickly there would be compensation so that the wave-length would remain the same. Returning to the mechanism, it might be modified by introducing n radial spokes (P) in one plane normal to the axis of the shaft in order to reduce the times between each pluck of the wire. It may be assumed that the waves per unit distance are then regulated by the number of plucks and the speed (taken longitudinally) of the plucker relative to that of the wire. This involves a

mechanical conception of the mechanism of radiation, and from Bohr's theory this idea may be faulty or it may require further elaboration.

Now P becomes in effect the *source of light*, so that to get any differential phenomena in the shape of a Doppler effect the operator's movement must be relative to the source P, but the velocity of light is always the same when uninfluenced by the presence of great masses of matter like the sun, or when it is not passing through more or less dense media, as in the Fizeau experiment. It may be here remarked that long light waves in free space have the same velocity as short light waves, the term *light* referring to all waves of electromagnetic origin.

As a corollary to the above, the velocity of light cannot be thought of in terms of measurement without a standard place of reference, so to speak, which becomes the point of inception of the wave. This being the case, the measurement must always be from this source, hence the constancy of the velocity of light. As a further consideration, assuming a wave of light started at some early time, when one breaks in upon such a wave train extending millions of miles for example, to speak of its velocity becomes absurd, because no origin is involved in this case. Sir O. Lodge hints at this in the following words:—"Einstein's second fundamental assumption is that the one absolute quantity which *can* be measured, namely, the velocity of light—if it be a velocity—is unique and so fundamental that every observer must necessarily measure the same result if he make his measurements correctly, no matter what his motion may be."—*Nature*, Aug. 4th, 1921.

Thus it will be seen that the absoluteness of the velocity of light follows directly from the fact that it is of necessity always measured from the source of its origin. This, of course, may be displaced a definite amount without affecting the result—it can be given a handicap as it were. Here then is a good example of the phenomenon being, so to speak, attached to its particular origin, and this is precisely the idea which obtains when considering line-domains.

* See CHEMICAL NEWS, Dec. 23 and 30, 1921, pp. 329, 350—this being practically a continuation of my previous article.

CONTACT CATALYSIS.*

By WILDER D. BANCROFT.²

It seems probable that progress in developing a theory of contact catalysis can be accelerated if we formulate more definitely the conditions of the problem, so that we can see what experiments should be done next. The first question to be answered is whether the catalytic agent can act at a distance by radiation. Miss Woker³ has given a sketch of the earlier speculations as to radiation. The only one which has survived is that of Barendrecht,⁴ whose calculations have been criticised severely by Henri.⁵ Trautz and Krüger⁶ have attempted to account for a number of phenomena in homogeneous solutions by postulating infra-red radiation. This idea has been developed by Lewis⁷ and applied to the change of reaction velocity with the temperature and to contact catalysis.

"Photochemical phenomena have demonstrated the fact that chemical change can be brought about as a result of absorption of radiation in the short-wave region. We are led to generalise this and to seek in radiation of longer wave-length the ultimate cause of ordinary or thermal reactions as well. It is obvious that every material system, in virtue of its temperature, contains radiation at the same temperature. Under ordinary conditions, *i.e.*, at ordinary temperatures, this radiation is mainly of the infra-red type. It is well known that electro-magnetic properties of substances, *e.g.*, the dielectric constant, are intimately connected with the radiation density in the material, and further, such properties have a marked effect upon the chemical activity of molecules, *e.g.*, the electrolytic dissociating power of solvents which possess high dielectric constants. It will be readily accepted, therefore, that infra-red radiation

is the source of the energy which is required to bring about ordinary or thermal reactions."

By thermal reactions Lewis means reactions of the ordinary kind which proceed without being exposed to any definite external source of short-wave radiation such as is met with in the so-called photochemical reactions.

"For our present purpose the most significant phenomenon associated with thermal reactions is the influence of temperature upon the reaction velocity, the velocity constant increasing three or four fold for a rise of 10° in the neighbourhood of room temperature. It has long been known that this very great effect cannot be accounted for simply on the basis of an increase in the kinetic energy of translation of the molecule as a whole, for in the most favourable case this increase could not account for more than one or two per cent. of the observed effect, and it is doubtful whether the change so observed would be even in the right direction. It is evident, therefore, that the effect of temperature upon the velocity constant has to do not with the kinetic energy of translation but with the internal energy of the molecule.

From measurements of the specific heat it is known that, on the average, the increase in the internal energy per degree rise in temperature is not large. In the simplest cases the increase in internal energy varies directly as the absolute temperature, and hence a rise of 10° would cause an increase of approximately three per cent. in the average internal energy at ordinary temperatures. The influence of temperature on velocity cannot be ascribed therefore to the average increase in internal energy. When heat is added to a body, however, the energy does not distribute itself evenly among the molecules; instead, some receive no energy, others a moderate amount, and a very few receive excessively great amounts of energy. It would seem therefore that the influence of temperature on reaction-speed is to be sought in the fact that a very small number of molecules receive an abnormally large quantity of internal energy.

"By treating the problem of reaction velocity from the point of view of statistical

*The Presidential Address presented at the Thirty-seventh General Meeting of the American Electrochemical Society in Boston April 8, 1920.

Transactions of The American Electrochemical Society 1920 xxxviii.

² By Wilder D. Bancroft, Professor of Physical Chemistry, Cornell University.

³ *Die Katalyse* (1910) 60.

⁴ *Zeit. phys. Chem.* (1904), 49, 456; (1906), 54, 307; *Proc. Kon Akad. Wet. Amsterdam* (1919), 22, 29.

⁵ *Zeit. phys. Chem.* (1905), 51, 19.

⁶ *Zeit. Electrochemie* (1911), 17, 453.

⁷ *Jour. Chem. Soc.* (1914), 105, 2330; (1915), 107, 233; (1911), 109, 55, 67, 796; (1917), 111, 457, 1086; (1918), 113, 471; (1919), 115, 182; *System of Physical Chemistry* (1919), 3, 138.

mechanics it is possible to correlate the velocity constant with the temperature as has been done by Marcelin⁸ and later in a more exact manner by J. Rice.⁹ The relation between the observed velocity constant k and the absolute temperature T for a simple type of gaseous reaction is shown by Rice to be

$$d \log k / d T = E / RT^2$$

This expression is, as a matter of fact, a slightly simplified form, a small term having been neglected. In deducing this expression it has been assumed that a molecule reacts when its internal energy has been raised to a certain critical value which is in general large compared with the average internal energy of the molecule. This critical limit is known as the critical energy of the molecule. The term E denotes the difference between the critical energy and the average or mean internal energy reckoned per gram-molecule. E may therefore be called the critical increment; E denotes the amount of energy which has to be added to make an average gram-molecule react. It is at this point that the radiation hypothesis of chemical reactivity enters, the assumption being that the quantity E is contributed by the absorption of infra-red radiation of a given frequency which the substance is capable of absorbing. It is assumed that this energy is communicated in terms of quanta, the same assumption as is made by Einstein in obtaining his expression for the photochemical equivalent.

"It will be observed that the Marcelin-Rice equation is identical in form with the empirical equation of Arrhenius, which is known to be in good agreement with experiment. A considerable advance has been made, however, in that the empirical term A , which occurs in Arrhenius' equation, is now replaced by the term E to which a definite physical significance can be attached. In the case of polymolecular reactions the active molecular state actually exists, as is shown by the experiments of Baly and F. O. Rice;¹⁰ the rate of observed chemical reaction depends then upon the frequency of collision between activated molecules.

"In the case of unimolecular change, molecules in the active state do not exist, for it is assumed that when a molecule becomes active it immediately decomposes and

becomes transformed into resultant. If the action be reversible, it follows, on the statistical basis of the expression, that the activated resultant has exactly the same critical energy as the activated reactant. This does not mean that the E term is the same for both reactant and resultant, E being the difference between the critical and mean internal energies.

"Granted that the critical increment is due to radiation, and further assuming that a single quantum is capable for accounting for the E of a single molecule; it can easily be shown from a knowledge of the magnitude of the temperature coefficient of a reaction, that the effective radiation must belong to the short infra-red region, *i.e.*, of the order $1-3 \mu$, in the case of reactions which occur with sensible velocity at ordinary temperatures."

In order to apply this hypothesis to contact catalysis it is only necessary to postulate that the catalytic agent emits a suitable infra-red radiation, that the sum of the critical energy increments necessary to activate the reactants at the surface of the catalytic material and the energy necessary to absorb the products of the reaction are less than those required to activate the reactants in the free state.

Lewis¹¹ has done some remarkable work in the way of calculating absorption bands and of establishing relations between the critical energy increment and the heat of reaction; but he seems never to have shown experimentally that the reaction velocity is actually due to infra-red radiation. For instance methyl acetate has a strong absorption band between 5.8μ and 11μ and the hydrogen ion is supposed to emit wavelengths over the range $1.1-11 \mu$; but no attempt has been made to see whether infra-red radiations really accelerate the catalysis of methyl acetate. Lewis¹² tries to meet this objection in an interesting way. "In order that any of Planck's relations may be employed, it is essential that temperature radiation alone be considered, and further that the radiation and the matter composing the system be in temperature equilibrium. On Planck's view, the interchange between matter and radiant energy is effected through the medium of oscillators, situated in the molecules of the matter present. In the case of photochemical reactions as ordi-

⁸ Comptes rendus (1914), 158, 161.

⁹ Brit. Ass. Rep., 1915, 397.

¹⁰ Jour. Chem. Soc. (1912), 161, 1475.

¹¹ Jour. Chem. Soc. (1914), 105, 230; (1916), 109, 55; (1917), 111, 457, 1036.

¹² *Ibid.* (1916), 109, 796; System of Physical Chemistry (1919), 2, 138.

narily carried out, the temperature of radiation is much higher than that of the system on which the radiation acts. To such cases Planck's expressions do not apply. It is necessary to emphasise this point, as it is not generally recognised that there is this fundamental difference between thermal and photochemical processes."

I am not prepared to admit the existence of this fundamental difference. While it is perfectly true that in photochemical work, the source of light is at a higher temperature than the object which reacts photochemically, that is merely an experimental convenience and not a theoretical necessity. The essential thing is to have wave-lengths which are absorbed by the reacting substance and it is immaterial how they are generated. If we could generate them mechanically at ordinary temperature, they would have the same photochemical action.

This point is not essential, however. If the catalytic action of hydrogen ion, for instance, is due to infra-red radiation, we ought to get acceleration when the hydrogen ion is in another vessel, provided the vessel and the solvent do not absorb those particular infra-red radiations which are assumed to be effective. It is not a question of difference of temperature. In the same way, it ought not to be necessary theoretically to bring the mixture of sulphur dioxide and air in actual contact with the platinum. This would eliminate the danger of poisoning the catalytic agent. It is possible that this can be done; but I know of no experiments showing it, and I am not certain that Lewis really believes that it can be done since he assumes¹³ that gases are adsorbed in the atomic form and are therefore more active because the heat of dissociation may be ten times the heat of adsorption or condensation.

Lewis¹⁴ does say: "It is evident that the optimum condition for the transfer of a quantum from a catalyst individual to a molecule of reactant occurs when the two are in contact and this according to the theory of probabilities is proportional to the product of the concentrations of the reactant and catalyst." This is taking radiation in a very narrow sense. Rideal¹⁵ apparently agrees with Lewis and yet says that "the conception that adsorption is the primary

action in all cases of heterogeneous catalysis is the viewpoint now generally adopted." I do not myself see any necessary connection between adsorption and a theory of contact catalysis based on infra-red radiations unless one is to assume explicitly that the infra-red radiations do not reach appreciably beyond the adsorption layer, in which case we are not dealing with action at a distance and it becomes impossible at present to say whether any of the effects are really due to infra-red radiation.

Until some proof is brought that a contact catalytic agent can act at a distance, we are justified in postulating that the reaction takes place in or at the surface. A corollary from this is that any substance, which cuts down the rate at which the reacting substances reach the catalytic surface¹⁶ or which prevents them from reaching it, will decrease the reaction velocity and may destroy the catalytic action entirely. Berliner¹⁷ has shown that traces of fatty vapours from the air or from the grease on the stop-cocks will decrease the adsorption of hydrogen by palladium from nearly nine hundred volumes practically to nothing. Faraday¹⁸ has shown that traces of grease destroy the catalytic action of platinum on oxyhydrogen gas. De Hempinne¹⁹ has apparently shown that carbon monoxide cuts down the adsorption of hydrogen by palladium, though his method of presenting his results is very obscure. Lungé and Harbeck²⁰ found that carbon monoxide inhibits practically completely the catalytic action of platinum on a mixture of ethylene and hydrogen. Schönbein²¹ pointed out that the hydrides of sulphur, tellurium, selenium, phosphorus, arsenic, and antimony act very energetically in cutting down the catalytic action of platinum on mixtures of air with hydrogen or ether. He considered that the hydride must decompose, giving rise to a solid film. This is not necessary in order to account for the phenomenon; but he seems to have been right in at least one case, for Maxted²² has found that hydrogen sulphide is decom-

¹⁶ Taylor: Trans. Am. Electrochem. Soc. (1919), 36, 149.

¹⁷ Wied. Ann. (1888), 35, 903.

¹⁸ Experimental Researches on Electricity (1839), 1, 185.

¹⁹ Zeit. phys. Chem. (1898), 27, 249.

²⁰ Zeit. anorg. Chem. (1898), 16, 50.

²¹ Jour. prakt. Chem. (1843), 29, 238.

²² Jour. Chem. Soc. (1919), 115, 1950.

¹³ Lewis: Jour. Chem. Soc. (1919), 115, 184.

¹⁴ Jour. Chem. Soc. (1916), 109, 800.

¹⁵ Trans. Am. Electrochem. Soc. (1919), 36, 195.

posed by platinum black with evolution of hydrogen and that the platinum then does not adsorb hydrogen.

Langmuir²³ points out that "the action of oxygen in preventing the dissociation of hydrogen by a heated tungsten filament is clearly that of a catalytic poison. It has been shown previously²⁴ that the dissociation of hydrogen takes place only among hydrogen molecules adsorbed on the surface of the tungsten. The only way in which oxygen can prevent such action in a high vacuum is by the actual presence of oxygen atoms on the surface. Since the dissociation at 1,500° K. is entirely prevented by the oxygen, and since the range of atomic and molecular forces does not exceed the dimensions of the atoms, it must follow that much more than half the surface must be covered by oxygen atoms or molecules. For if the surface were only half covered, then, according to probability laws, uncovered areas several times as large as the diameters of atoms would not be of rare occurrence, and on these areas dissociation could occur."

²³ Jour. Am. Chem. Soc. (1916), 38, 2272.

²⁴ *Ibid.* (1916), 38, 1145.

(To be continued)

THE BOARD OF TRADE.

SAFEGUARDING OF INDUSTRIES ACT.

TWO COMMITTEES APPOINTED UNDER PART II.

Under the powers conferred upon them by Part II. of the above Act the Board of Trade have referred to a Committee, of which Dr. J. H. Clapham, C.B.E., is the Chairman, a complaint that Gold Leaf manufactured in Germany is being sold, or offered for sale, in the United Kingdom, under conditions to which the Safeguarding of Industries Act applies. The Committee propose to hold their first sitting for taking evidence at 2.30 p.m., on Monday, 9th January, 1922, at 5, Old Palace Yard, London, S.W.1. The Secretary to the Committee is Mr. D. Haigh, Board of Trade, Great George Street, London, S.W.1, to whom all communications should be addressed.

Reference has also been made to a Committee, of which Sir W. M. Acworth is the Chairman, a complaint that Aluminium Hollow-ware, Wrought Enamelled Hollow-ware, and Plain and Enamelled Baths

manufactured in Germany are being sold, or offered for sale, in the United Kingdom under conditions to which the Act applies. This Committee propose to hold their first sitting for taking evidence at 2.30 p.m., on Monday, 9th January, 1922. The Secretary of this Committee is Mr. H. F. Hile, B and of Trade, Great George Street, London, S.W.1, to whom all communications should be addressed.

SAFEGUARDING OF INDUSTRIES ACT. PART I.

EXCLUSION OF SANTONINE.

The Board of Trade announce that the Referee, after hearing a complaint under Section 1 (5) that Santonine had been improperly included in the lists of articles chargeable with duty under Part I of the Act, has given a judgment upholding the complaint; and accordingly Santonine is withdrawn from the lists as from the 20th December.

RUBBER PAPER FOR NEWSPAPERS.

The London correspondent of the *Manchester Guardian Commercial* writes in today's issue:—"Researches which have been going on in London for some time past point to the strong probability that newspapers will at no great distance of time be printed on paper produced from rubber instead of on paper made from wood-pulp, as now. I learn that the results already derived from the investigations are such that art paper of the kind used in the production of fashion journals and the big illustrated newspapers can be made from rubber. Further experiments are to be made with a view to making newsprint from the same material, and it is on this point, perhaps, that interest in the printing industry will mainly centre."

TECHNICAL RECORDS OF EXPLOSIVES SUPPLY 1915-1918.

No. 4.

THE THEORY AND PRACTICE OF ACID MIXING.

A special series of reports is being published for the Department of Scientific and Industrial Research in order to make available, for the benefit of the industries concerned, results of scientific and industrial value contained in the technical records of the Department of Explosives Supply of

the Ministry of Munitions. The work recorded was done at or in connection with some of the National Factories during the War. The preparation of the necessary abstracts of information was begun by the Ministry of Munitions at the close of the War, and arrangements were afterwards made by the Department of Scientific and Industrial Research to complete them.

Three reports of these series have already been published, viz.:—

No. 1. Recovery of Sulphuric and Nitric Acids from Acids used in the Manufacture of Explosives: Denitration and Absorption. Price 12s. 6d., by post 13s.

No. 2. Manufacture of Trinitrotoluene (TNT). Price 17s. 6d., by post 18s.

No. 3. Sulphuric Acid Concentration. Price 12s., by post 12s. 7d.

Copies of these reports may be obtained from H.M. Stationery Office at the following addresses:—

Imperial House, Kingsway, London, W.C.2, and

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37, Peter Street, Manchester;

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UNEMPLOYMENT AMONG MINERS.

Unemployment among the workers of the mining industry tends steadily to decrease, while there is also a decline in the number of men on systematic short time.

According to the Board of Trade figures, the estimated number of insured workpeople in the industry is at present 1,140,670. The number of unemployment books remaining lodged on December 2nd was 139,335, which represents a percentage of 12.2, or 1.7 per cent. less than on November 4th.

Compared with the other great industries of the country, unemployment in the mining districts is not high.

BRITISH INDUSTRIES FAIR.

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This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

33645—Chenische Fabrik in Billwater. Process of producing high percentage pure anthracene. December 14.

33980—Dyson, H. G. T. Flush chemical valve. December 17.

33370—Gulf Refining Co. Recovery of aluminium chloride. December 12.

33532—Hadden, A. J. H.—Treating liquids with decolorizing, purifying and filtering agents and separating undissolved substances from liquids. December 13.

33661—Hilditch, T. P.—Metanation of water gas and manufacture of methane. December 14.

33441—Koch, M.—Manufacture of pure nitro-carbonic acid mixture from combustion gases. December 14.

Specifications Published this Week.

172,046—Thermal Industrial and Chemical Research Co.—Process for de-tinning iron.

172,056—Imray, O. Y.—Manufacture of easily soluble diazotisable azo-dyestuffs.

172,074—Naef, E. E.—Recovery of sulphur from sulphuretted hydrogen and ammonium sulphide and gases containing such.

172,101—Perkins, W. G.—Treatment of complex sulphide ores.

172,177—Imray, O. Y.—Manufacture of new dyestuffs.

172,205—Schantz, K.—Manufacture of bichloride or mercure.

Abstract Published this Week.

Alkyl Amides of Aromatic Sulphonic Acids.—Patent No. 167,941.—A process of obtaining Alkyl Amides of Aromatic Sulphonic Acids has been invented by Messrs. Chemical Manufacturing Co., Ltd., of 8, Waterloo Place, London. Aromatic sulpho-chlorides, alkylamine salts, and substances neutralizing the acid produced, for instance alkaline-earth or alkali carbonates, are caused to react in the presence of a small quantity of water, not exceeding 10 per cent. and preferably less than 5 per cent. of the weight of the reagents. A solvent or deluent such as benzol may be added. Heat may be applied. The alkyl sulphonamide produced, for instance monomethyl zylene sulphonamide, may be extracted with benzol. Dialkyl amides may be also prepared by the process. If larger quantities of water are used and the base omitted, there is obtained a compound readily soluble in water, probably a substituted ammonium compound.

Messrs Raynor & Co. will obtain printed copies of the published specifications and will forward on post free for the sum of 1s. each.

THE ROYAL INSTITUTION OF GREAT BRITAIN.

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LECTURES BEFORE EASTER 1922.

FRIDAY EVENING DISCOURSES

addressed to members and their friends at 9 p.m.

January 20.—Sir James Dewar, LL.D., D.Sc., F.R.S., M.R.I., Fullerian Prof. of Chemistry. "Soap Films and Molecular Forces."

January 27.—Viscount Burnham, J.P.—"Journalism."

February 3.—Lieut.-Colonel Sir Francis Young-husband, K.C.S.I., K.J.L.E.—"The Mount Everest Expedition."

February 10.—W. D. Halliburton, M.D., LL.D., F.R.S., Prof. of Physiology, King's College, London. "The Teeth of the Nation."

February 17.—Dr. S. M. Watson, M.Sc., Jodrell Prof. of Zoology and Comparative Anatomy, University of London. "History of the Mammalian Ear."

February 24.—John Joly, D.Sc., F.R.S., Prof. of Geology, University of Dublin.—"The Age of the Earth."

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—"Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot-Watt College; Prof. of Chemistry to Royal Academy.—"The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., F.R.S., M.R.I., Prof. of Chemistry University of London. "Auxiliary International Languages."

March 31.—Arthur B. Wakley, B.A., Author of "Drama and Life," etc.—"Jane Austen."

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—"Evolution of the Elements."

Mr. A. A. Campbell Swinton, M.Inst.C.E., F.R.S., will give a lecture on "The Johnsen-Rahbek Electrostatic Telephone and its Predecessors," at 4 p.m., on January 4th, and at 8 p.m., on January 5th. Mr. F. Harrison Glew will give a lecture on "Radium; its application in Peace and War," at 8 p.m., on January 4th, Professor F. J. Cheshire, C.B.E., being in the chair. All the lectures will be illustrated by experiments. Other discourses are being arranged. Over 50 firms are exhibiting scientific apparatus and a number of experimental demonstrations have been arranged.

We understand that invitations have been given to the Institution of Electrical Engineers, the Institution of Mechanical Engineers, the Chemical Society, the Faraday Society, the Wireless Society of London, and the Röntgen Society. Admission in all cases will be by ticket only, and therefore members of the societies just mentioned desiring to attend the exhibition should apply to the secretary of the society to which they belong. Others interested should apply direct to F. E. Smith, O.B.E., F.R.S., Hon. Secretary of the Physical Society, Admiralty Research Laboratory, Teddington, S.W.

THE OPTICAL SOCIETY.

The next ordinary meeting of the Society will be held at the Imperial College, on Thursday, January 12, 1922, at 7.30 p.m.

The following papers will be presented:—

"The Manufacture of Optical Glass." By Dr. C. J. Peddle, M.B.E., F.I.C., F.Inst.P.

"The Barr and Stroud 100-ft. self-contained Base Rangefinder." By Dr. James W. French, F.Inst.P.

"The Optical Three Apertures Problem." By T. Smith, M.A., F.Inst.P.

THE PHYSICAL SOCIETY AND OPTICAL SOCIETY'S ANNUAL EXHIBITION.

This exhibition, which is to be held on Wednesday and Thursday, January 4th and 5th, 1922, at the Imperial College of Science, South Kensington, will be open in the afternoon (from 3 to 6 p.m.), and in the evening (from 7 to 10 p.m.).

NOTICES.

EDITORIAL.—All literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the EDITOR.

SUBSCRIPTIONS £1 12s. per annum, payable in advance, should be addressed to the MANAGER.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3222.

CONTACT CATALYSIS.

By WILDER D. BANCROFT.

(Continued from last week.)

Harned²⁵ has shown that the rate of adsorption²⁶ of chlorpicrin by a charcoal which has been cleaned by washing with chlorpicrin is much greater at first than by a charcoal which has not been so cleaned, although the final equilibrium is apparently about the same in the two cases. This is analogous to the evaporation of water when covered by an oil film. The oil cuts down the rate of evaporation very much, but has practically no effect on the partial pressure of water at equilibrium. Taylor points out that normally the time of contact between a gas and the solid catalytic agent is extremely small and consequently anything which decreases the rate of adsorption will cut down the reaction velocity very much.

It is easy to see that the piling up of the reaction products will cut down the reaction velocity, if they prevent the reacting substances from coming in contact with the catalytic agent. This has been observed in the contact sulphuric acid process.²⁷ The explanation that the decrease in the reaction velocity is due to a decreased adsorption of the reacting substances was first given by Fink,²³ who is the real pioneer in this line. Although the reaction between carbon monoxide and oxygen is practically irreversible at ordinary temperature, Henry²⁹ recognized that the presence of the reaction product might slow up the rate of reaction, and he proved his point by increasing the reaction velocity when he removed the carbon dioxide with caustic potash. Water vapor checks the catalytic dehydration of

ether³⁰ and of alcohol³¹ and hydrogen cuts down the catalytic dehydrogenation of alcohol.

W. C. McC. Lewis³² points out that the explanation of the poisoning of catalytic agents on the basis of adsorption leads to certain conclusions in regard to the temperature co-efficient. "One of the chief difficulties met with in the kinetics of heterogeneous reactions has its origin in the selective nature of the adsorbability of the reactants and the resultants, particularly the latter. The so-called catalytic poisons are now generally regarded as owing their effect to marked selective adsorption, as a result of which the surface of the catalyst becomes covered with a layer of molecules and is thus no longer capable of catalyzing the reaction. In many cases the resultants of the reaction are adsorbed in this manner and consequently function as a catalytic poison. Since the extent of adsorption diminishes as the temperature rises, it is obvious that when such poisoning effects are present the temperature co-efficient of the reaction velocity over a certain range of temperature is not comparable with that over a different range, for the total observed velocity depends not only on the true effect of temperature on the chemical process, itself, but likewise on the alteration in the extent of active surface presented to the reactants. The simplest conditions are obviously those in which the adsorption effects are a minimum, and such conditions will occur generally when the energy required for sublimation or desorption is small. In the other cases, where adsorption effects are large, it is necessary to correct the observed velocity constants for the change in the area of the effective surface produced as a result of the change in temperature. Thus in the case in which the resultant is markedly adsorbed, and therefore acts as a negative catalyst, the temperature co-efficient will possess too high a value and, instead of decreasing as tem-

²⁵ Jour. Am. Chem. Soc. (1920), 42, 946.

²⁶ Taylor: Trans. am. Electrochem. Soc. (1919), 36, 149.

²⁷ Bodländer and Koppen: Zeit. Elektrochemie (1903), 9, 566; Beil: Zeit. anorg. Chem. (1905), 44, 267.

²⁸ Bodenstein and Fink: Zeit. phys. Chem. (1907), 60, 61.

²⁹ Phil. Mag. (1836), (3), 9, 324.

³⁰ Ipatieff: Ber. deutsch. chem. Ges. (1904), 37, 2996.

³¹ Engelder: Jour. Phys. Chem. (1917), 21, 676.

³² Jour. Chem. Soc. (1919), 115, 182.

perature rises, may even increase. A similar abnormal behavior is to be anticipated when a reaction proceeds partly in the homogeneous gaseous phase, partly in the surface, for, as the temperature rises, the reaction tends to predominate in the gaseous phase, and therefore possesses a higher temperature coefficient.

We have seen that the poisoning of a catalytic agent is due to marked adsorption, which cuts down the adsorption of the reacting substances. We have also seen that the presence of sulphur trioxide tends to decrease the rate of reaction of sulphur dioxide and oxygen. We can now imagine a hypothetical case in which one of the reaction products is adsorbed so strongly that it acts as a poison. In that case we shall get entirely different results depending on the amount of catalytic agent present. If there is a large excess of catalytic agent the reaction will run to an end or to true equilibrium before the catalytic agent is entirely poisoned. If, on the other hand, there is only a small amount of catalytic agent, it will be poisoned very early in the course of the reaction and we shall have an apparent equilibrium reached from only one side which will vary with the amount of catalytic agent. For any given amount of catalytic agent we shall get an apparently definite end-point; but the value of the end-point will vary with the amount of catalytic agent taken. At least one case of this sort has been recognized definitely. Neilson³³ has studied the splitting of salicin and of amygdalin by platinum black. "It is found that the amount of splitting of salicin in a given time reached a maximum, and then with increasing time the amount of splitting was not proportional to the time, being materially less in the last twenty-four hours than it was in the preceding. This is due, no doubt, to the effect of the products of the splitting—especially the saligenin. It is more probably due, however, to the salicylic acid produced by the oxidation of saligenin to salicylic acid by the platinum. It is well known that

salicylic acid has a marked retarding action on enzymes as shown by Kastle and Loevenhart³⁴ in its action on lipase; and by Neilson³⁵ in its action on platinum black in

the hydrolysis of ethyl butyrate.

The experiments with amygdalin and platinum black were carried out in the same way as those with salicin. It was anticipated, however, that the amount of splitting by the action of platinum black on the amygdalin would be small, as it is well known from Bredig's work on the catalysis of hydrogen peroxide by colloidal platinum,³⁶ and from Neilson's work³⁷ on the hydrolysis of ethyl butyrate by platinum black, that hydrocyanic acid has a marked retarding action on the catalytic action of platinum. One of the splitting products of amygdalin is hydrocyanic acid; and according to the above experiments one would expect the action of platinum black on amygdalin to be retarded, if not stopped entirely. Such, indeed, was found to be the case, as the first experiment with tightly corked flasks was entirely negative. It occurred to me that by leaving the flasks uncorked the hydrocyanic acid would volatilize and the action would then proceed. This is in keeping with the well-known fact that removing one of the products of a chemical reaction allows the action to go on to completion. By leaving the flasks uncorked it was found by a qualitative test that platinum splits up the amygdalin. It was further seen that the action did not go on to completion, as the amount of sugar produced was small."

Since enzymes are poisoned by many substances in something the same way that colloidal platinum is, it seems worth while to see whether autotoxic catalysis would account for some of the peculiarities in enzyme action which have puzzled people. If autotoxic catalysis occurs, we should expect that the presence of the reaction products would cut down the reaction velocity even though the reverse reactions were negligible. If the poisoning action of the reaction products is sufficient, we should get false equilibria if we started with small amounts of the enzymes and the reaction would run to an end if we took larger amounts of the enzymes. Both these phenomena have been observed.³⁸

³⁵ Am. Jour. Physiology (1903), 10, 197.

³⁶ Bredig: Anorganische Fermente (1900), 68.

³⁷ Neilson: Am. Jour. Physiology (1903), 10, 197.

³⁸ Tammann: Zeit. phys. Chem. (1895), 18, 426; Kastle and Loevenhart: Am. Chem. Jour. (1900), 24, 491.

³⁴ Am. Chem. Jour. (1900), 24, 491.

³³ Am. Jour. Physiology (1906), 15, 148.

The poisoning of colloidal platinum in its action on hydrogen peroxide solutions is undoubtedly due to adsorption; but we have no direct measurements on the adsorption and consequently we do not know positively that this is the right explanation and we do not know that there may not be other factors which have been overlooked.

Since reaction velocity is probably directly proportional to the difference of chemical potential and inversely proportional to the chemical resistance, we can increase the reaction velocity either by increasing the difference of chemical potential or by decreasing the chemical resistance. When the reacting substances are adsorbed at the surface of a catalytic agent, there is a marked increase in the concentration and it has been suggested that this is the cause of catalytic action. As a matter of fact, the effect of concentration seems to be relatively unimportant in most of the cases studied hitherto. Patrick's silica gel has a surface of 2.5×10^6 cm² per gram and is an excellent adsorbent; but, so far, it does not have any marked catalytic effect except in the oxidation of nitric oxide. It would be interesting to try this substance at 100° with the mixed vapors of alcohol and acetic acid, because this reaction takes place at a measurable rate in the vapor phase in the absence of any catalytic agent. It is stated that oxyhydrogen gas has been found to be quite stable under pressures of two thousand atmospheres, which shows that the catalytic action of platinum on mixtures of hydrogen and oxygen must be due to something more than a change in concentration. The marked difference in the behavior of platinum and charcoal toward oxyhydrogen gas is another argument in favor of the action of a catalytic agent being specific.

If we have selective adsorption of the reaction products, this will cause a lowering of the chemical potential of the resultants³⁹ and will therefore increase the reaction velocity. It may even determine the direction of the reaction. Alcohol breaks down into acetaldehyde and hydrogen in presence of pulverulent nickel and into ethylene and water in presence of pulverulent alumina. Since nickel adsorbs hydrogen strongly and alumina adsorbs water, it seems natural to

assume that the selective adsorption is the determining factor.⁴⁰

While this seems very satisfactory, there are certain points which must not be overlooked. When making ethylene at Edgewood Arsenal during the war, it was found advisable to have a large amount of steam present with the alcohol vapor in order to make temperature regulation easier. This undoubtedly decreased the rate of decomposition of the alcohol; but that difficulty was overcome by working at a higher temperature. I find it very difficult to see how alumina can dehydrate alcohol in presence of a large amount of water vapor if the reason the alumina acts is because of its strong adsorption of water vapor. In spite of the fact that the selective adsorption of the reaction products is my own pet theory and in spite of the fact that it undoubtedly contains a great amount of truth, it must be admitted that, as now formulated, it is not the final word. It must be modified before it can be considered as satisfactory. If it breaks down temporarily in the simple case of the decomposition of alcohol, it is not surprising that we cannot as yet predict the decompositions of the esters by means of it.

If changes in the chemical potential are not the important factors in contact catalysis, the catalytic agent must change the chemical resistance in some way. So far as I can see, there are two possible ways in which this might happen. We may have more effective collisions between existing molecules or we may have a conversion of one or more of the reacting substances into an active form.

According to the kinetic theory the reaction velocity is proportional to the number of collisions between possibly reacting molecules; but it does not follow at all that two molecules react every time they collide. If a large number of collisions is necessary on an average before a pair of molecules react, anything which would make these collisions more helpful might increase the reaction velocity enormously. The first question is then whether there is any evidence of ineffective collisions. This matter has been studied by Strutt,⁴¹ who comes to the conclusion that a molecule of ozone reacts every time it strikes a molecule of silver oxide; but that a molecule of active nitrogen collides with a molecule of copper oxide five

³⁹ W. C. McC. Lewis suggests the terms reactants and resultants for reacting substances and reaction products.

⁴⁰ Bancroft: Jour. Phys. Chem. (1917), 21, 591.

hundred times on an average before they react, while two molecules of ozone at 100° collide on an average 6×10^6 times before they react. Without insisting on the absolute accuracy of these figures there is evidently plenty of margin for an increase in reaction velocity with ozone at 100° if one could produce more effective collisions. Langmuir⁴¹ finds that 15 percent of all oxygen molecules at a pressure of not over 5 mm striking a tungsten filament at 2770° K react with it to form tungstic oxide, WO_3 . This coefficient increases at higher temperatures and at 3300° K about 50 percent of all the oxygen molecules which strike the filament react with it to form WO_3 . Since there are three atoms of oxygen in WO_3 and only two in the oxygen molecule, Langmuir considers that at least one-half of the tungsten surface must be covered at 3300° K with oxygen in some form.

⁴¹ Proc. Roy. Soc. (1912), 87, A, 302.

⁴² Jour. Am. Chem. Soc. (1915), 35, 105; (1916), 38, 2270.

JAPANESE PATENT LAW.

H.M. Ambassador at Tokio reports that by Imperial Ordinance, published in the Official Gazette, dated December 17th, 1921, the revised Law relating to patents, trade-marks, etc., and intitled "The Utility Model Law" (Law No. 97, promulgated on April 29th, 1921, in "Official Gazette" No. 2622 of Saturday, April 30th, 1921), will be enforced as from January 11th, 1922.

A copy of the Law may be inspected by United Kingdom firms interested on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. The regulations concerning the enforcement of the Law have not yet been received in the Department. Upon receipt of such regulations a further announcement will appear in the "Journal."

TRANSITION ELEMENTS AND THE OCTET THEORY.

With a new arrangement of the Rare Earth Elements in the Periodic Classification.
By R. G. W. NORRISH, B.A. (Cantab).

It is now considered probable by many that in the Lewis-Langmuir theory we have the nucleus of a consistent explanation of the Periodic properties of the elements.

Nevertheless the theory in its present stage is not entirely satisfactory and certain disadvantages have yet to be overcome. The most important of these, in the opinion of the author, are those connected with the elements commonly known as the transition elements, the elements leading up to them in the Periodic Table, and with the Rare Earth metals.

The chemical properties of these elements are not satisfactorily explained in all their relationships by the electronic arrangement laid down by Langmuir's fourth postulate,¹ and to obtain a consistent explanation it appears to be necessary to adopt the idea of variability of electronic structure for the elements in question. This possibility has already been dealt with by one author² with a certain measure of success, although the question cannot be said to be in a satisfactory state. It is the object of this paper to examine the question from the point of view of colour and valency relations, which will be shown to lead to the periodic arrangement adopted in Table I.

It will be observed that in the first long period there are eight consecutive elements, commencing with Titanium and ending with Copper, all of which give coloured cations in solution. Furthermore all except Copper and Nickel give two series of cations, the one divalent and the other trivalent. The elements preceding Titanium, and those following Copper in the long series in question are all colourless in the ionic state, and nearly always exhibit only their normal group valency.

The following series of salts may be cited as an example of the above statement.

¹ According to Langmuir's fourth postulate the electrons in the atom tend to arrange themselves in concentric shells round the central nucleus; of these the first contains two electrons, the second eight, the third eight, the fourth eighteen, the fifth eighteen, and the sixth thirty-two. Thus the third shell is completed by the element Argon, while the fourth is commenced with Potassium, with one electron in the outer shell, and completed with Krypton with eighteen electrons outside, each successive element in this long series having one more electron in the outer shell than in the element preceding it.

² R. Bury; Jour. Am. Chem. Soc. (1921), 43, p. 1062.

TABLE I

[illegible]

TABLE II.

Trivalent Series.	Colour	Divalent Series	Colour
ScCl ₃	Colourless	CaCl ₂	Colourless
TiCl ₃	Violet	TiCl ₂	Yellow
VCl ₃	Green	VCl ₂	Lavender
CrCl ₃	Green	CrCl ₂	Blue
MnCl ₃	Green	MnCl ₂	Pink
FeCl ₃	Yellow	FeCl ₂	Green
CoCl ₃	Red	CoCl ₂	Blue
		NiCl ₂	Green
		CuCl ₂	Blue
GaCl ₃	Colourless	ZnCl ₂	Colourless

The fact that these elements are able to form trivalent ions indicates that there are in all cases three loose electrons which can be lost to a negative element or radicle in salt formation. In the formation of the divalent series of salts only two of the electrons are utilised. The following Table gives the number of ions remaining in the outermost shell of the ions in the two series of salts.

It will be convenient to call this outermost shell of electrons of the above ions the

Subsidiary Shell. In the case of Copper immediately following Nickel in the Periodic Classification, the subsidiary shell consists of 8 electrons, while there are in the case of the metal 3 electrons outside, corresponding to the three electrons lost in salt-formation in the case of the elements considered above. Of these either two or one can function as valency electrons. In the former state it is assumed that as the subsidiary shell now contains 8 electrons, there is no tendency for it to absorb more, and the remaining electron of the "Cupric ion

TABLE III.

-ic Salts Trivalent Ions	No. of Electrons in outside shell	-ous Salts Divalent Ions	No. of Electrons in outside shell
Ti'''	1	Ti''	2
V	2	V''	3
Cr	3	Cr''	4
Mn	4	Mn''	5
Fe	5	Fe''	6
Co	6	Co''	7
(Ni)	(7)	Ni''	8

Cu⁺⁺ will remain outside loosely held and is probably responsible for the colour of the ion. In the case of the Cuprous ion there are two electrons outside, which form a stable pair, analogous to the pair of electrons in the Helium atom; this ion is colourless. Onward from Copper a new octet is built up of which Cuprous Copper is the first member, giving rise to a series of elements closely resembling the elements in the first two short series.

The stable complex of the Cuprous ion may be represented by the formula (2.8.8.8.2.) where the numbers within the brackets refer to the numbers of electrons in the successive shells. Around this as a basis the new octet is built up as we proceed onwards through the series. Furthermore, inasmuch as the metallic ions following Copper in this series of elements all possess this formula, having parted with their outside electrons, we should expect them to be colourless, in analogy with the Cuprous ion. When the final member of the series, Krypton, is reached, the electrons forming the shells 8, 2, and the newly completed shell of 8, take their places in the new stable shell of 18, so that the electronic formula of Krypton may be written (2.8.8.18.) after Langmuir.

Let us now return to the coloured ions of the series. There can be little doubt that these ions owe their property of absorbing light in the visible part of the spectrum to the electrons in the subsidiary shell. Colour in this series commences abruptly with the Titanic iron, which contains one electron Cuprous ion in which the subsidiary shell has completed an octet. Further evidence on this point is furnished by the substance Calcium subchloride CaCl_2 ,³ which exists in the form of red crystals. The substance is unstable in solution, but in accordance with the prevailing views on crystal structure, we may regard the ions as preserving their identity within the crystal. The electronic structure of the *Ca'* ion would be given by (2.8.8.1.),⁴ thus corresponding to the Titanic ion (2.8.8.1) in electronic arrangement, and as we should expect by analogy, it is coloured. The single outside electron in the case of the *Ca'* ion is held so loosely that it is lost in solution, forming stable

Ca' ions. The single outside electron in the Titanic ion is however more strongly held by reason of the greater nuclear charge existing on this ion, so that it is stable in solution.

It thus appears that after Titanium has been passed the tendency of the component electrons of the outer shell to build up an octet gradually disappears. We see it remaining in Titanium, Vanadium, Chromium and Manganese in compounds where the highest or the group valency is exhibited, as in the Titanates, Vanadates, Chromates and Permanganates, all of which can be built up on the simple cubical system, with the help of Langmuir's idea of covalences.⁴ For these elements, however, the alternative arrangement outlined above must be assumed in order to account for the compounds in which lower valencies are exhibited, and for this reason the elements may be termed variable elements. The electrochemical quality of a given atom in the two short series is determined by the number of electrons it possesses in its outer shell, the shell being also responsible for the valency relations. In the case of the variable and transition elements of the first long series, however, the outer shell is occupied by the three valency electrons and their electrochemical properties may in a general way be said to approximate to those of Aluminium, which they resemble in this point of structure.

The building up of the subsidiary shell is not attended by any marked change of chemical character as it proceeds, because it is not the outermost part of the atom, existing as it does inside the ring of three valency electrons and is therefore not directly responsible for the electrochemical properties. Nevertheless the stability of this form of electronic arrangement increases as the number of electrons in the subsidiary shell increases, giving rise to a gradual increase in the metallic properties as we proceed towards Nickel.

The fact that Nickel does not give a stable

⁴Langmuir: *Jour. Am. Chem. Soc.* (1919), 41, 1543.

The term *covalence* indicates the number of pairs of electrons which any given atom shares with its adjacent atoms.

³*Zeit. Electrochem.* (1902), 8, p. 757.

series of trivalent salts may be ascribed to the strong tendency for one of the 3 outer valency electrons to be drawn into the subsidiary shell and thus complete a stable shell of eight. This tendency is vanishingly small in the earlier members, for in the case of Iron all three, and in the case of Cobalt two, of the valency electrons would have to be absorbed by the subsidiary shell, to produce the octet, a task to which the nuclear charge is presumably unequal. In the case of Nickelous ions, the octet formed is probably in an unstable state, a fact to which we can ascribe its colour. When we come to the next element, Copper, the nuclear charge has increased by one unit, and with it the stability of the completed subsidiary shell, while the colour of the Cupric ion is due, as stated before, to the loose electron held outside this stable shell.

The same variability of structure is exhibited by the metals corresponding to the above in the next long series, with the exception that Zirconium, which would be the first member of the variable group, appears to adhere strictly to the octet arrangement, and to give no compounds in which it exhibits a valency lower than that of the typical group valency of 4. Its compounds are colourless.

The second member of the group, Niobium, shows marked trivalent properties, e.g., it forms a violet crystalline trichloride. Molybdenum gives both a dichloride and a trichloride, the former being yellow and the latter red.

The chlorides of the members of the variable and transition elements of the second long series are as follows:

TABLE IV.

Trivalent Salts	Colour	Divalent Salts	Colour
NbCl ₃	Violet	MoCl ₂	Yellow
MoCl ₃	Red		
RuCl ₃	Orange Yellow	RuCl ₂	Blue
RhCl ₃	Dark Red		
(PdCl ₃)	Red)	PdCl ₂	Garnet Red

Silver with which the subsidiary octet is completed gives only ions analogous in structure to the colourless Cuprous ion.

There is a tendency in this group of coloured elements for a fourth electron to come into the outer sphere of valency electrons, giving rise to such compounds as RuCl₄ and PdCl₄. All these Tetravalent salts are coloured.

We have seen above from chemical considerations that it is necessary to postulate a variable electronic structure for certain of the elements occurring towards the centre of the first two long series. This alternative structure consists in building up a subsidiary ring of electrons whose stability increases as the number of electrons it contains approaches 8. Furthermore, the subsidiary ring has been seen to be closely connected with the colour of the cations in solution or crystals. It is therefore significant that when we come to the third and longest series of 32 elements, the above principles still hold with slight modification.

The fortunate work of Moseley⁵ enables us to predict with certainty the exact number of the Rare Earth elements. This being so, it can be definitely asserted that there are 16 Rare Earth elements, beginning with Lanthanum and ending with Lutecium. The similarity of properties shown by these among themselves, as well as their trivalency, reminds us of the similarity exhibited by the seven variable elements in the two preceding long series. Again, the fact that nearly all the Rare Earth metals

⁵Moseley: *Phil. Mag.* (1914), VI., 27, 703. Soddy: *Ann. Rep. Chem. Soc.* (1914), XI., 278. Langmuir: *Am. Chem. Jour.* (1919), 41, p. 874.

give strongly coloured ions in solution encourages us to look for an analogous explanation of their similarity and colour.

If we consider the elements Cerium to Platinum as variable elements, we can write them in three rows of seven elements under the seven variable elements of the two previous series. The element Lanthanum finds its place in the Aluminium column. When this is done it will be seen that the members of the Rare Earth group, giving colourless ions, are all segregated. Lanthanum gives colourless ions and comes under the colourless elements of the Aluminium group. The elements Cerium, Terbium and Lutecium occurring in the first group of the Rare Earth block, and the elements Gadolinium and Ytterbium occurring in the last group, are the only Rare Earth elements giving colourless ions. It will be seen that those two groups are really adjacent.

As to the reason why the variable elements of the third long series should be so numerous and occur in three groups of 7, analogous to the single groups of 7 in the preceding long series, no definite answer can be given. Such a question is intimately bound up with the mechanics of stability of the atom. It would appear that in this long series the subsidiary shell, after the first seven electrons have been added, duplicates itself instead of completing the octet and finally adds a third layer of seven electrons before commencing a fresh external octet and finishing the series in the normal way. It will be observed that in the case of Platinum there are 3 completed subsidiary rings of 7 electrons and 3 valency electrons. The inactivity of Platinum in the metallic state may be due to the absorption of these three electrons to produce three stable octets, giving a structure analogous to the Rare Gases of Group O.

The advantages of this arrangement of the Rare Earth elements in the Periodic Classification are manifest when we come to consider other physical properties of the atoms. Firstly, it puts the Rare Earth elements in a compact group under the elements to which they are most strongly analogous in chemical properties. Secondly, a rectangle can be drawn round the variable

elements (including Cu, Ag, Au and Zr) which includes all the elements giving coloured ions. All these elements (excluding Cu, Ag, Au and Zr) are paramagnetic, most of them strongly so especially at high temperatures.⁶ Gadolinium is probably next after iron, Cobalt and Nickel in magnetic properties; all the elements of the Rare Earths, whose paramagnetism has been measured, have a much greater susceptibility than Manganese. Values of the susceptibility, taken from Landolt Bornstein Tabellen, are included in the Periodic Table given. Of the elements to the right of the rectangle, all except Tin, which is feebly paramagnetic, are diamagnetic. Of the elements to the left, some are feebly paramagnetic and others diamagnetic.

Again⁷ if we consider the elements in the Periodic Classification given, from the point of view of the oscillation frequencies⁸ it will be seen that the elements within the rectangle maintain a constant high value for any given series, the elements on either side of the rectangle dropping abruptly to very much smaller values. So far as the evidence goes, the same may be said for the latent heats of evaporation⁹ per gram-molecule. The above data, where known, are included in the Periodic Table, as also are the compressibilities.¹⁰ In the case of

⁶ It would seem that high magnetic susceptibility like colour is dependent upon the presence of the subsidiary ring in the atom in an incomplete form (i.e., containing less than 8 electrons). In the case of Cu, Ag and Au, which cannot be considered variable in the sense adopted above, the subsidiary ring of 8 is complete, while as before stated, Zr does not exhibit variability.

⁷ The Author wishes to express his indebtedness to Dr. E. K. Rideal for drawing his attention to the important relations mentioned in this paragraph, and also for much helpful criticism of the whole paper.

⁸ W. C. McC. Lewis, *Physical Chemistry*, Vol. III., p. 61.

Rideal, *Proc. Camb. Phil. Soc.* XX. (1921), p. 298.

¹⁰ T. W. Richards, *Zeit. Phys. Chem.* (1908), 61, p. 183.

this latter property, it will be seen that the elements within the transition are conspicuous for their low compressibilities, there being a considerable increase from 200-300 c.c. immediately we leave it.

It is highly probable that the above physical properties depend on the external field of force at the atom, and their tendency to a constant value, among the variable elements of a given series of the Periodic Table, would therefore indicate that the external fields of force of the atoms of these elements approximate to a constant value. That these elements can all lose three electrons in ion formation is a further point in favour of this deduction.

In passing hypothetically from one element to that of the next highest atomic number, the nuclear charge is increased by one unit, and at the same time an electron is added to the outside of the atom. It must be supposed that in the case of the variable elements this produces but a very small effect on the external field of the atom, i.e., the extra unit of nuclear charge and the electron practically neutralise each other.—On the other hand it has been mentioned that the variable elements in their highest state of oxidation resemble the typical members of the short series, e.g., Manganese imitates Chlorine in Permanganates; the tendency to cubic symmetry is therefore not entirely absent in the structure of these atoms.—It was shown, however, that a more stable alternative arrangement was probable,—the subsidiary shell—in the case of the tri- and di-valent salts of these elements. It now appears that these elements must possess this alternative structure in the free state, for we should expect that if free Manganese, for example, possessed the cubic symmetry of the free Chlorine molecule, it would resemble it in physical properties. This is obviously not the case as all the variable elements are metallic in the free state and quite different in physical properties from the typical non-metals of the short series. The constancy of the external fields of these variable elements can, however, be connected with the presence of the subsidiary shell in their free atoms. We have already seen that as we add electrons to this subsidiary shell, in passing from one element to the next in the

series, the electrochemical nature of the cations in solution is not greatly affected. It is therefore most likely for this reason, and also from what has been said above, that in passing from one variable element to the next, the electron is added to the subsidiary shell, and approximately neutralises the effect of the added unit of nuclear charge on the external field of the atom.

The electronic formulae of the free atoms of the elements of the first long series can now be written as follows, the kernel being placed in brackets and the valency electrons outside.

Ar (2.8.8.)	Zn (2.8.8.8.2.) 2
K (2.8.8.) 1	Ga (2.8.8.8.2.) 3
Ca (2.8.8.) 2	Ge (2.8.8.8.2.) 4
Sc (2.8.8.) 3	As (2.8.8.8.2.) 5
Ti (2.8.8.1.) 3	Se (2.8.8.8.2.) 6
V (2.8.8.2.) 3	Br (2.8.8.8.2.) 7
Cr (2.8.8.3.) 3	Kr (2.8.8.18.)
Mn (2.8.8.4.) 3	} Variable Elements giving coloured Ions.
Fe (2.8.8.5.) 3	
Co (2.8.8.6.) 3	
Ni (2.8.8.7.) 3	
Cu (2.8.8.8.) 3	

Similar formulae can be written for the other long series. In the Rare Earth series as mentioned, however, the subsidiary shell can contain up to 21 electrons in the case of Platinum and 22 in the case of trivalent Gold. Monovalent gold, the first member of the new octet, is represented by the electronic formula (2.8.8.18.18.8.8.8.) 1, the kernel of which is common to all the subsequent members of this long series.

NOTE.—After this paper was written the attention of the author was drawn to a very similar form of the Periodic table, given by Professor Stewart in the latest edition of his book, "The Recent Advances of Physical and Inorganic Chemistry."

A HIGH PRESSURE DUE TO ADSORPTION.

By WILLIAM D. HARKINS AND D. T. EWING.
Continued from Dec. 30th issue.

3. RELATION OF THE TOTAL APPARENT PORE VOLUME TO THE COMPRESSIBILITY OF THE LIQUIDS.

The most remarkable feature of Tables I. and II. is that the apparent density and total pore (capillary and micropore) volume depend upon the liquid in which the charcoal is immersed, and in general both increase markedly either as the compressibility increases or the viscosity decreases. This suggests alternative hypotheses, which lead to practically opposite conclusions with respect to the density. The first of these, supported also by the later data obtained by Mr. Monroe, is that the *liquid in the micropores is very highly compressed by adsorption, and that this compression is greater, the greater the compressibility of the liquid in bulk.*¹¹ That the molecules of the liquid should be drawn closer to the atoms in the surface layers and edges, seems to be the normal supposition when the magnitudes of the adhesional forces are taken into account, since such forces are much more intense than those which hold the molecules of liquid together. While this may not have been proved directly, it is evident that the energy of adsorption for a charcoal surface is very much higher than the energy of cohesion in water or in an organic liquid, since the energy of vaporization of such an adsorbed liquid is very much greater than that of the liquid itself. In addition to this the work of this laboratory has shown that even on a mercury surface the energy of adhesion for these liquids is usually three or more times that in the pure liquids. It should be noted that this factor is altogether too low to express the relations at a carbon surface.

However, the compressive effect need not vary directly as the compressibility of the liquid in bulk, since the liquid is not compressed iso-tropically. A second factor which might be expected to cause a divergence is that the force of adhesion is not the same for all of the liquids. When these

factors are considered, the agreement in the order seems very remarkable.¹²

When the highly evacuated lump of charcoal is put under the surface of a liquid, the latter enters the capillaries or macropores, and these in the charcoals which preserve to a considerable extent the original structure of the shell, have diameters of the order of 0.012 mm. in diameter, so they are filled quickly, provided they are in direct communication with the liquid, but the micropores are filled much more slowly. In the capillaries the driving force of penetration is the surface tension, while the retarding force is the viscosity, and the speed of penetration should vary as the ratio σ/η where σ represents the surface tension and η the viscosity. That this is true has recently been shown by Washburn. It might be thought that the differences in the volumes of the liquids which penetrate the charcoal are due to incomplete penetration by some of the liquids, especially in the cases of water and propyl alcohol, but there is *no parallelism* between the values of the ratio $(\sigma/\eta)^{1/2}$ and the volume of liquid which penetrates. However, as the pores become finer the influence of the viscosity may become predominant, especially when the liquid, after passing through a part of a narrow pore, enters into a region where its cross section becomes enlarged.

While a consideration of the relation between the pore volumes and the viscosities of the liquids as presented in Table I., shows that the data would in general support the idea that the effects might be due to different penetrations of the charcoal by the different liquids, the least viscous penetrating most, it will be seen that the propyl alcohol is very badly out of order in this sense, though in exactly the order prescribed by the compressibility hypothesis. Since several other liquids have been found by Mr. Monroe which are also out of order with respect to viscosity, but in the order of the compressions, it seems evident that at least the greater part of the observed differences in volume is due to the compression of the liquid, though the viscosity may exert a minor influence upon them.

¹⁰ All of these data refer to the lump density.

¹¹ The second hypothesis suggested, that the most viscous liquids penetrate least, does not seem to be in good agreement with the experimental data, as indicated later in the text.

¹² This indicates that the variation of the adhesive force with a change from water to various organic liquids, is not very great. This agrees with the conclusion of Lamb and Coolidge (Ref. 4).

The apparent densities in water of the coconut-shell charcoals as given above are 1.843 and 1.863; that of the similar charcoal used by Titoff, 1.86; by Baerwald, 1.92; and by Miss Homfray, 1.66; by Cude and Hulett, 1.854 on 18- to 20- mesh, and 1.900 for the same charcoal of 100- to 200-mesh (per inch). Kerosene gave very nearly the same apparent density with charcoal E 602 as benzene, or about 2.008. With this may be compared the data obtained by Chaney and Apmann, who determined the apparent density in kerosene of 30 charcoals, and found that the lower the value of this quantity, the lower in general is the service time. Thus densities in kerosene of 2.14, 2.17, 2.11, 2.11, 2.08, 2.02 and 2.02, correspond respectively to service times of 68, 64, 60, 59, 57, 55, and 54 minutes; while at the other extreme, densities of 1.98, 1.86, 1.87, 1.66, 1.63, and 1.66, correspond to service times of 33.1, 30.7, 27.6, 17.8, 8.0, and 4.3 minutes. Their data are in good agreement with the value found here, since a density of 2.02 in kerosene, the value corresponding to Table I., was found by them to correspond to a service time of 41 to about 49 minutes, which is not very far from that given in Table I.

However, there is not such good agreement with the data obtained by Cude and Hulett,⁶ as is shown in Table III.

TABLE III.

APPARENT DENSITIES OF TWO SPECIMENS OF
COCONUT-SHELL CHARCOAL.

Liquid	Cude and Hulett Charcoal A 909 (18- to 20-mesh)	This investigation Charcoal E 602 (10- to 14-Mesh)
Water	1.854	1.843
Benzene	1.797	2.008
Carbon disulfide	1.915	2.067

The discrepancy in the sign of the difference exists only in the single case of benzene. This liquid exhibited the same relative order in our investigations of two other charcoals, A and No. 1, so its position in the series can hardly be an accident, especially as many determinations were run for charcoal E 602. Some factor was evidently present in the work of Cude and Hulett⁶, which was absent in our own. It is possible that the discrepancy is due to the extent of the outgassing, which was more thorough in our work, since we happened to have a very much more rapid vacuum pump, used a large connecting tube in place of their capillary, and outgassed for 3 days.

It is of interest to note that in the more active charcoals the apparent volume of ethyl ether, minus the volume of water, in the pore of 1 cc. of charcoal ($-\Delta v$),—which shows how much more the ether is compressed than the water—is nearly constant and about 0.055 cc., as is shown by Table IV.

TABLE IV.

COMPRESSION OF ETHER IN CUBIC CENTIMETERS
PER CUBIC CENTIMETER OF CHARCOAL, MINUS THE
COMPRESSION OF WATER ($-\Delta v$).

Charcoal	Service time, minutes,	$-\Delta v$
Rankinite A	42.9	0.052
Active carbon 4	40.9	0.067
Charcoal 1	32.0	0.053
E 621	27.0	0.051
Active carbon 1	19.0	0.043
Active carbon 3	1.10	0.018
Cedar wood charcoal	0.0	0.008
Beechwood charcoal	0.0	0.004

Of these charcoals the last, made from beechwood, was the poorest adsorbent for chloropicrin as determined by the regular test. It is apparent that the value of $-\Delta v$ is nearly constant as the service time decreases from 47 to 27 minutes, but falls very rapidly as the service time decreases to 19 and 11 minutes, while the charcoals which give practically a zero service time, give also a very small value for the compression decrement ($-\Delta v$).

4. THE HEAT OF ADSORPTION OF LIQUIDS IN CHARCOAL.

When lumps of outgassed charcoal are dropped into a liquid, or when a liquid is poured into a tube which already contains the charcoal, the liquid penetrates the charcoal, with the result that the carbon surface of the pores disappears, and a carbon-liquid interface takes its place. In this process heat is developed, and this may be specified as the heat of immersion, of adsorption ($-Q$), or of absorption. Thus 1 g. of bone charcoal, which had not been outgassed, gave off 18.5 calories when immersed in water, while the same weight of fuller's earth in the same liquid, gave 32 calories. The data of Lamb and Coolidge on the heat of adsorption of vapours by charcoal indicate that the heat of immersion of a typical coconut-shell charcoal in carbon disulfide is of the order of 35 calories per gram.

(To be continued)

NOTES ON BOOKS.

The Manufacture and Use of Explosives, with Notes on their Characteristics and Testing, for Chemists, Ordnance Officers, Mining Engineers and Students. By R. C. FARMER, O.B.E., D.Sc. and Ph.D., with a foreword by SIR ROBERT ROBERTSON, K.B.E., F.R.S. 116 pp., illustrated. London: Sir Isaac Pitman & Sons, Ltd., Parker St., Kingsway, W.C.2. Price 2s. 6d.

The foreword by Sir Robert Robertson at the commencement of the book stamps it with unquestionable authority. Dr. Farmer's experience at Woolwich before the war and his subsequent work in the Department of Explosives Supply to the Ministry of Munitions place him in a unique position for dealing with this important subject.

It is pleasing to think that the experience gained in the manufacture and use of explosives during the war can now be put to practical use for industrial purposes in mining, tunnelling and agriculture. The author in his preface refers to the universal wish that these uses may entirely supersede the destructive application of explosives, and he quotes the words of His Majesty King George V., in opening the War Museum in 1920, when he said:—

"We hope and pray that, realising all that we have done and suffered, future generations will look back upon the war, its instruments and organisation, as belonging to a dead past."

It is the author's aim to so distribute the knowledge gained in the manufacture of explosives during the war that it may be now put to peaceful uses. Although a certain amount of chemical knowledge is necessary to follow the preparation of explosives, there is nothing in the book that will prejudice the author's descriptions.

In the first 14 pages, after a few words concerning the discovery of gunpowder and explosives generally, a short description is given of various military explosives, with drawings and descriptions of shells and bombs. This is followed by details of the properties and tests of explosives and an account of the chemical nature of gunpowder, nitro-cellulose, picric acid, T.N.T. and various other nitro compounds.

Chapter XI. deals with detonators, mercury fulminate, and other detonating compounds. The final chapters are devoted to a brief description of fireworks. At the end of the little book there is a good bibliography, and it is well indexed.

Fuel and Lubricating Oils for Diesel Engines. By W. SCHENKER. 114 pp. Illustrated. Constable & Co., Ltd., 10-12, Orange St., London, 1921. Price 10s. net.

The book is mainly intended for owners and engineers in charge of Diesel engines. Within the last few years there has been a continual increase in the number of fuels found suitable for these engines. Special attention has been devoted to oil fuels, and a section has been given to the subject of lubricating oils. This is, of course, necessary, as the lubrication of an engine is as essential as is the oil used for its fuel; the methods of testing described will of necessity apply to both. The author certainly commences at the beginning of the subject, by going back to a general description of the early discovery of petroleum oils, and photographic reproductions are given of the oil wells and derricks at Baku and other localities. Good descriptions are given of the manufacture of tar oils, their composition and analysis.

In the middle of the book there are some tables of the analyses of fuels from tests made by the Swiss Federal Fuel Testing Laboratories at Zurich, which are very valuable. The illustrations are good, and the book is one that will certainly be sought after by engineers and works departments interested in Diesel engines.

At the end of the book tables are given for the conversion of degrees Centigrade into degrees Fahrenheit, and other useful dictionary and an encyclopædia.

A Dictionary of Chemical Terms. By JAMES F. COUCH. D. van Nostrand Co., 8, Warren St., New York. iv. plus 204 pp.

The need for a dictionary of this kind is very great, on account of the continual introduction of new definitions and terms. The aim of the author has been to produce something between a standard English dictionary and an encyclopædia.

We notice that under the heading of "Rays" the various forms of radiation that have played such a prominent part in physical science during the last few years are described with unusual accuracy.

The book is well printed and the descriptions, while brief, are very inclusive, and it has the advantage of being of small size and therefore very convenient for reference.

Oils, Fats and Fuels. By THOMAS HULL. Blackie & Sons, Ltd., 50, Old Bailey, London, Glasgow and Bombay. viii. plus 143 pp. Price 3s. 6d. net.

This book is intended for the use of students attending technical schools and classes, and the aim of the author has been to give as much general information upon the subjects as can be included in a small book. As far as possible, chemical formulæ have been omitted, but good practical information is given. The various processes described are well illustrated by the woodcuts and line blocks, and quite a number of half-tone plates are produced showing the method of gathering turpentine, the oil wells of Los Angeles, petroleum stills and other sundries.

This method of giving practical illustrations of the working of the various processes will undoubtedly be appreciated by teachers, as it gives students an intelligent idea of the methods of gathering and producing oils and fats.

The latter half of the book is occupied with fuels, the preparation of wood charcoal and coke, and a description of the present-day use of liquid fuels.

Each chapter of the book is followed by a series of questions upon the subjects that have been dealt with, for which answers are given in an appendix at the end.

Monographs of Physics. Edited by SIR J. J. THOMSON, O.M., F.R.S., and FRANK HORTON, D.Sc.

(A.) *Rays of Positive Electricity and their Application to Chemical Analysis.* By SIR J. J. THOMSON, O.M., F.R.S. Second Edition. x. plus 237 pp. Illustrated. Longmans Green & Co., London. Price 16s. net.

This work will be found of great value to those who are interested in the rapid progress of physical science. The author, in his preface, refers to the hope that he expressed on the publication of the first edition, that the positive rays would be found of service in connexion with important chemical problems. This hope has been fulfilled by the researches of Aston and others on the determination of atomic weights and the detection of isotopes. The author expresses his conviction that as yet we are only beginning a harvest of results which will elucidate the processes of chemical combination.

The book is fully illustrated with carefully-made diagrams of photographs which are familiar to most of us who have followed the remarkable researches carried out by Sir J. J. Thomson at the Cavendish Laboratory and the Royal Institution.

A work of this kind, which is really a publication by the author of those researches for which his name will always be famous, is outside of the scope of criticism. We are quite sure that the whole of the scientific world will be grateful to the author for having found time to collect together data that would otherwise be widely distributed and not always accessible.

At the end of the book there is given a large number of those remarkable photographs of the tracks of the Positive Rays and atomic matter which have brought those material particles, of which the chemical atom is built, within the sphere of vision.

(B.) *The Emission of Electricity from Hot Bodies.* By O. W. RICHARDSON, F.R.S. Second Edition. Illustrated. Longmans, Green & Co. Price 16s. net.

Professor Richardson, in his second edition of this valuable monograph, has endeavoured to bring the matter up-to-date and at the same time to correct some errors that unavoidably appeared in the first edition.

Reference is made to the rapid progress that has been effected within the last few years in the technical application of the emission of electrons from hot bodies, and he points out that these practical applications have become so numerous and important that it is not possible to include them in a work of this size. The author devotes himself to the discussion of the theory connected with the emission of electrons, the effects produced by gases and other fundamental problems.

An important chapter is given up to the emission of positive ions by hot metals, and the subject is carried back to experiments made by Dr. Guthrie in 1873, and a brief description is given of the rapid development that followed.

Reference is made to the observation by Edison of a fact which was noticed in the early days of incandescent lamp manufacture. Edison found that if an independent electrode was mounted between the two ends of the carbon filament in an electric lamp, a current was found to pass between

it and the positive terminal—but not between it and the negative terminal. This observation was followed by a great number of experiments by Preece, Fleming, Crookes, Elster, Geitel, and others, and has culminated in the transmission of speech from one side of the world to the other. These results are now familiar to everyone who reads the daily papers. By the great mass of people they are regarded merely as wonders of science, but the mass of experimental data given in Professor Richardson's book shows that these remarkable achievements have been attained only by painstaking study and ungrudging labour.

(SYNTHETIC ORGANIC CHEMICALS.)

We have received from the Research Laboratory of the Eastman Kodak Co., of Rochester, New York, their latest list of synthetic organic chemicals, containing the names of over 1,200 compounds now in stock. The Research Laboratory was originated about three years ago with the object of ensuring the independence of the country with regard to these essential materials. The progress of the laboratory has been very rapid, and the stock of products is being continually increased.

In the list the standard price is given for each product, according to the metric system, in quantities of from 5 to 1,000 grammes. The list is accompanied by a small booklet by Dr. C. E. Kenneth Mees and H. T. Clarke.

As is known to most members of the photographic industry, Dr. Mees left this country some few years ago to take up the position of Director of Research at Rochester, and the pamphlet in question is a highly interesting booklet giving the progress of the research laboratories under his and Mr. Clarke's direction. It is fully illustrated with photographic reproductions showing the actual laboratories and the apparatus used therein.

We sincerely congratulate the authors on the success of their work, which will be for the benefit of chemists generally.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF RADIOLOGY AND PHYSIOTHERAPY (B.A.R.P.).

The above association has recently been incorporated under the Companies Acts.

The object is to advance the subject of Radiology and Physiotherapy under the direct control of the medical profession.

This is a step that has been contemplated for some time past, and it is one that cannot fail to be to the public benefit, the application of the recent advances in the science of radiology to the needs of the medical profession has been of enormous value, and it is fitting that a power which may be either a very great gain or a very great danger should be entirely under the control of a recognised public body.

We note that the names of the original subscribers are those of the leading members of the profession, and wish the Association every success.

THE INSTITUTION OF ELECTRICAL ENGINEERS. COMMEMORATION MEETING.

For the purpose of commemorating the first meeting of the Society of Telegraph Engineers, which was held on February 28th, 1872, the Council of the Institution of Electrical Engineers (originally the Society of Telegraph Engineers) are arranging for the following Institution functions to be held on dates approximately corresponding to that of the original meeting:—
Tuesday, February 21st, at 4 p.m.—Popular

Lecture (admission by ticket, a limited number of seats being reserved for guests), by Professor J. A. Fleming, F.R.S., on "Michael Faraday and the Foundations of Electrical Engineering."

Tuesday, February 21st, at 7 p.m. (for 7.30 p.m.).—Annual Dinner at the Hotel Cecil.

Wednesday, February 22nd, at 8.30 p.m.—Professor Fleming will repeat his Lecture of the previous day.

Thursday, February 23rd, from 4 to 6 p.m. and from 8 to 10 p.m.—A number of members of the Institution and others closely connected with the early

development of Electrical Engineering will give short discourses on their reminiscences and experiences during the early history of the Electricity Supply Industry. The speakers will deal both with matters of scientific and technical interest and also with the effect of legislative action on the progress of the industry.

This is only a preliminary announcement, and full particulars will be published later.

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, ALbemarle Street, W.1.

LECTURES BEFORE EASTER 1922.

FRIDAY EVENING DISCOURSES

Addressed to members and their friends at 9 p.m.

January 20.—Sir James Dewar, LL.D., D.Sc., F.R.S., M.R.I., Fullerian Prof. of Chemistry.—“Soap Films and Molecular Forces.”

January 27.—Viscount Burnham, J.P.—“Journalism.”

February 3.—Lieut.-Colonel Sir Francis Young-husband, K.C.S.I., K.C.I.E.—“The Mount Everest Expedition.”

February 10.—W. D. Halliburton, M.D., LL.D., F.R.S., Prof. of Physiology, King's College, London.—“The Teeth of the Nation.”

February 17.—Dr. S. M. Watson, M.Sc., Jodrell Prof. of Zoology and Comparative Anatomy, University of London.—“History of the Mammalian Ear.”

February 24.—John Joly, D.Sc., F.R.S., Prof. of Geology, University of Dublin.—“The Age of the Earth.”

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—“Problems in the Variability of Spectra.”

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot-Watt College; Prof. of Chemistry to Royal Academy.—“The Pigments and Mediums of the Old Masters.”

March 24.—F. G. Donnan, C.B.E., D.Sc., F.R.S., M.R.I., Prof. of Chemistry University of London.—“Auxiliary International Languages.”

March 31.—Arthur B. Walkley, B.A., Author of “Drama and Life,” etc.—“Jane Austen.”

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.L., Prof. of Natural Philosophy, R.I.—“Evolution of the Elements.”

ROYAL INSTITUTION.

On Tuesday next (Jan. 17) at 3 o'clock Dr. F. H. A. Marshall begins a course of two Lectures at the Royal Institution on “Physiology as Applied to Agriculture”; on Thursday (Jan. 19) Mr. Seton Gordon

gives the first of two Lectures on (1) “Mountain Birds of Scotland,” (2) “Sea Birds and Seals”; and on Saturday (Jan. 21) Dr. Charles Macpherson, Organist of St. Paul's Cathedral, commences a course of two Lectures with musical illustrations on “The Evolution of Organ Music.” The Friday Evening Discourse on Jan. 20 will be delivered by Sir James Dewar on “Soap Films and Molecular Forces,” and on Jan. 27 by Viscount Burnham on “Journalism.”

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the EDITOR.

SUBSCRIPTIONS £1 12s. per annum, payable in advance, should be addressed to the MANAGER.

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The owners of BRITISH PATENTS Nos. 2116/11 and No. 12946/15, “Processes relating to the manufacture of Ammonia,” desire to dispose of the Patents or to enter into working arrangements with a firm likely to be interested.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3223.

GRANTS TO UNIVERSITIES.

IMPORTANT LETTER.

An important letter has been addressed to the Prime Minister by the Universities of Birmingham, Durham, Leeds, Liverpool, Manchester, and Sheffield, and a similar one has been sent by the Universities of Oxford, Cambridge, London, Bristol, Wales, Glasgow and Aberdeen.

Realising the importance of the matter and the great danger of reducing the grants made by the Government to Universities at the present juncture, we venture to reproduce the full text of the communication.

To the Right Honourable David Lloyd George, M.P.

SIR,

On behalf of the Sister Universities of Birmingham, Durham, Leeds, Liverpool, Manchester and Sheffield, which provide opportunities of University education for twelve thousand students, the great majority of whom live in the Midlands and North, we beg leave to submit to you the following considerations against any reduction being made in the amount of the grants paid by Government towards the cost of the work of Universities and University Colleges in Great Britain. In doing so, we desire to express our obligation to His Majesty's Government for the notable help given to the Universities towards their support during recent years.

2. Recognising the need for the utmost economy in public expenditure at the present time, our Universities have restricted their outlay within the narrowest limits consistent with their continued educational efficiency. To this end personal sacrifices are being made, and many developments, in themselves not only desirable but urgently needed, have been foregone. But we are persuaded that the grants now made to us by Government are at the lowest level at which the due discharge of our duties to the nation can be guaranteed, and that any retrenchment would be hurtful to public interests and wasteful of outlay already made.

3. Shortly after the outbreak of war in

1914, the Committee on Public Retrenchment contemplated the suspension of all grants paid by Government to the Universities and University Colleges. A memorandum was forthwith submitted to that Committee on August 26th, 1915, by the Vice-Chancellors of the sister Universities of Manchester, Liverpool, Leeds and Sheffield. The Committee on Public Retrenchment did not recommend the withdrawal of the University grants. In consequence, the Universities were enabled during the continuance of the war to render to the nation services previously unforeseen, and subsequently acknowledged by the Government as of vital importance.

Mr. Austen Chamberlain, referring to this subject in Birmingham, said that "there was not an aspect of national life in which the acquired experience of the Universities did not render assistance without which it was difficult to say how we could have won the victory which eventually crowned our efforts."

It is certain that, if the means are not withheld from them, the British Universities are in a position to render not less signal service to the nation during the coming years of peace.

4. The Universities, now organised upon a popular basis, give opportunity to the young men and women of the rising generation from every type of home. The University in England and in Wales has become (as it has long been in Scotland) representative of the whole people.

The Universities are the recruiting and training grounds for the great professions and for the public services, local and central. The Sacred Ministry, Medicine and Dentistry, the Teaching Profession, the Legal Profession, as well as the administrative services, rely mainly upon the Universities for the maintenance of their high standards.

The Universities train both workers and leaders for industry. They educate chemists, physicists, steel experts, civil, mechanical and electrical engineers, architects, farmers, colliery managers, metallurgists, textile managers, gas engineers, dyers and leather trade experts.

The Universities advance science. They are the chief centres of research. Their work has helped to enrich British industry and commerce and has added millions to the national wealth.

The Universities extend the frontiers of knowledge in all other departments of study—in history, with its bearing on politics; in economics; in international law; in psychology, which throws light upon movements of opinion; and in languages, the study of which meets many Imperial needs.

The Universities, on whose behalf we write, are open on equal terms and in all respects to men and to women. Aid from public funds has alone made it possible for them to offer the opportunity of a University education at a fee which has kept them accessible to applicants of promise but of slender means.

By means of student self-government and by the corporate life in residential halls, the Universities train men and women for the responsibilities of citizens, whether as leaders or in submission to the common will.

In fact, the Universities hold the keys of the future, for they supply practical needs of the Empire which cannot be met from any other source.

5. The funds which they now command are already inadequate for the needs of the British Universities.

(a) Almost all of the Sister Universities have sustained a heavy loss on the working of the last academic year.

(b) All are short of what should be spent annually, even upon the least adequate scale, in order to attract a succession of the best recruits for the filling of vacancies in the teaching staffs. This deficiency is not less than half a million pounds a year.

(c) All are short of the means of providing for advanced students in general, and for those from Overseas in particular, opportunities of study and research. Failure to meet the requirements of overseas students will weaken the bonds of the Commonwealth.

6. In order to meet their urgent needs our Universities have made every effort of self-help, and in this have been loyally supported by the students and their parents, as well as by private benefactors, by large firms, and by the local authorities of the areas which we serve.

(a) We have practised severe economy in all structural expenditure and in the maintenance and equipment of laboratories.

(b) We have raised the fees for courses of study and for examination by considerable amounts. This can only be justified as an emergency measure. About a third of the total income of our Universities comes from students' fees.

(c) We have collected from private benefactors during the last three years £1,175,000 for the maintenance and, where necessary, the development of the Universities.

(d) The local authorities of our areas have supported us by increasing their annual grants from £74,268 to £135,868. (Detailed figures are given in the Appendix).

The Government urged us to make the efforts which have led to this measure of success by encouraging us to hope that what we raised locally would be met by a corresponding increase in Government Grants.

7. In other countries, with which Britain must endeavour to hold her own, renewed exerts have been made since the War to strengthen the resources of Universities. The latter are held by the Governments and electorates concerned to be indispensable factors in the strength of the nation and are reckoned among the chief sources of its intellectual, administrative, and commercial power.

In Germany the Governments have shown that they attach the highest importance to Universities as centres of training for the professions, for responsible posts in industry and commerce, for scientific expert knowledge, and for the public services. They regard the Universities as homes of research for the advancement of knowledge and its application to national policy and to human welfare. Furthermore, they encourage and aid the Universities to provide wider opportunities of adult education for men and women who cannot reside at them for full-time courses of study.

In the United States, the generous endowment of Universities puts Britain to the blush. Gifts to Universities, whether they are maintained from corporate funds or by the State, are a conspicuous feature of modern American life. It is there felt that, in whatever else economy must be practised, Universities should be generously maintained, and that expenditure upon them from public funds is not only one of

the most profitable of investments, but an indispensable guarantee of national welfare. Gifts to Universities, up to 15 per cent. of the donor's income, are by Federal Law exempt from Federal Income Tax. The liberality of private benefactors is thus encouraged by a tempting concession from public funds.

In Canada, not only the great incorporated Universities like McGill, but the State Universities, receive increasing subsidies from public funds and gifts from private benefactors. Canadians feel that they cannot afford to lag behind the United States in University development, and they would regard with concern any failure on the part of Britain to maintain her Universities in high and increasing efficiency.

8. But retrenchment in the present grants would threaten the Universities with debility, and would check their growth as democratic institutions. Their work is part of the life insurance of the nation. To fail to keep up the premiums would, we submit, be unwise. A refusal to spend upon Universities what University work requires would discredit Britain in the eyes of other peoples, not least in the eyes of the sister nations of the Commonwealth, and would disconcert and dishearten the most intelligent of our citizens, especially those of the younger generation.

We have the honour to be, Sir,

Your obedient Servants,

C. GRANT ROBERTSON,
Principal of Birmingham University.

DAVID DRUMMOND,
Vice-Chancellor of Durham University.

M. E. SADLER,
Vice-Chancellor of Leeds University.

J. G. ADAMI,
Vice-Chancellor of Liverpool University.

HENRY A. MIERS,
Vice-Chancellor of Manchester University.

W. H. HADOW,
Vice-Chancellor of Sheffield University.

10th December, 1921

A HIGH PRESSURE DUE TO ADSORPTION.

By WILLIAM D. HARKINS AND D. T. EWING.
Continued from Page 24, January 13 issue.

THE HEAT OF ADSORPTION OF LIQUIDS IN CHARCOAL.

The heat of immersion of a solid whose surface is so nearly plane that its surface energy is essentially equal to that of the same area of a plane surface of the same material, or the heat of adsorption of a liquid on the surface of the solid, may be defined in a corresponding way as the amount of heat liberated ($-Q_a$) when a solid with a surface of this type, and of an area of 1 sq. cm. is immersed in a liquid in such a way as not to increase materially the area of the surface of the liquid. In this process the surface of the solid would disappear, and in its place would appear the same area of interface solid-liquid. The heat liberated ($-Q_a$) would be equal to the total amount of energy given off in the process when carried out iso-thermally (E_a), and this is equal to the total surface energy of the solid (E_s), minus the total surface energy of the interface (E_i), for 1 sq. cm. of surface. Since the total surface energy is always equal to the free surface energy (γ) plus the latent heat of the surface ($-T \frac{\delta \gamma}{\delta T} - l$), the following equation expresses the value of the heat of adsorption.

$$-Q_a = E_a - E_s - E_i = \gamma_l + l_i - (\gamma_s + l_s) - \left[\gamma_s - T \frac{\delta \gamma_s}{\delta T} - \gamma_l + T \frac{\delta \gamma_l}{\delta T} \right] \quad (1)$$

It is obvious that this equation is also valid for the heat of immersion of a liquid, or for the heat of adsorption of one liquid on the surface of another liquid, so in its more general sense the subscript *s* refers to the phase whose surface is already developed, but later disappears, giving place to an interface of the same area. The heat liberated on the immersion of a solid has always been found to be a positive quantity, which indicates that the total interfacial energy per unit area is always less, so long as this holds true, than the total surface energy of the solid. That this is not always the correct sign of the effect, at least when only liquids are involved, is shown by the fact that hexane, octane, and carbon tetrachloride have negative heats of immersion in water equal respectively to -0.21 , -0.21 , -0.26 , times 10^{-6} calories

per sq. cm. at 20°, though the heats of immersion of water in these liquids are all positive, 1.4, 1.34 and 1.05 times 10^{-6} calories per sq. cm. Even in the case of two liquids heat is almost always evolved on immersion as the result of the surface energy changes. Thus, for example, the heat of immersion of normal octyl alcohol at 20° in water is 1.28, and of water in octyl alcohol, 2.85, in terms of the units used above.

The heat liberated on adhesion ($-Q_A$), and the total adhesional energy (E_A), are always larger positive (or smaller negative) quantities than those which give the heat liberated on immersion (heat of adsorption), provided the surfaces are plane. The following equation gives the heat of adhesion.

$$-Q_A = L_1 + E_s + E_l - E_i \quad (1)$$

$$(\gamma_s + l_s) + (\gamma_l + l_l) - (\gamma_i + l_i) \quad (2)$$

These are the same as the heat and energy of approach, since the surfaces of two phases already in existence approach each other and disappear, while an interface, equal in area to that of either surface which disappears, takes their place. The heat of adhesion is 2.6 for water-hexane, 4.0 for water-octyl alcohol, 2.5 for water-carbon tetrachloride, all in 10^{-6} calories per sq. cm. at 20°.

When a liquid spreads over a solid, the surface of the solid disappears, while an interface of the same area appears. If the solid has a plane surface, then a liquid surface of the same area also appears; so, provided the liquid layer is not too thin, the following equation holds.

$$-Q_s = E_s + E_l - E_i + E_i = 0$$

$$\gamma_s + l_s - (\gamma_l + l_l) - (\gamma_i + l_i) = E_{s,l} - E_i$$

where E represents the energy of surface cohesion of the liquid.

Obviously,

$$-Q_A = E_A + E_s - E_l$$

or the heat liberated by the adsorption of a liquid equals the energy of adhesion minus the surface energy of the liquid. Also

$$-Q_s = E_s = E_{s,l} + E_l$$

and

$$E_{s,l} = E_A - 2 E_l$$

The heat of adsorption of a saturated vapour is

$$Q_s = (\gamma_s + l_s) - (\gamma_l + l_l) + \lambda = E_s - E_l + \lambda$$

where $-Q_s$ is the heat of adsorption of enough vapour to form a liquid in bulk covering the solid surface at constant temperature, and λ is the latent heat absorbed in the vaporization of the liquid per unit volume of vapour. It is assumed here that the area of the surface of the liquid formed is negligible in comparison with the area of the interface which is formed.

While we do not have the values of the above quantities for carbon, they have been determined in this laboratory for the interfaces between mercury and other liquids; in which case the values for the liquid mercury may be substituted for the values for the solid in the above equations. The heat of adsorption as defined above is thus found to be 3.25 for *iso*-butyl alcohol, 2.60 for *secondary* octyl alcohol, and 3.13 for octane, all in 10^{-6} calories per sq. cm. The heat of spreading of *n*-octyl alcohol on water is about that of *iso*-butyl alcohol on mercury, but that for octane on water is less than half the similar value for mercury.

5. THE AREA OF THE SURFACE EXPOSED TO A LIQUID INSIDE ONE GRAM OF CHARCOAL.

That there is anything in a lump of charcoal which corresponds to a plane surface is altogether improbable; and it is not unlikely that what corresponds to a surface may be molecularly rough, so that it would be impossible to designate any number which would correspond to the area in square centimeters of the surface. However, several estimates of this surface area have been made. Thus Lamb, Wilson and Chaney⁸ have estimated the surface in 1 g. of an activated charcoal as 1,000 square meters, Lowry and Hulett¹³ obtain the value 200 square meters for a similar charcoal, while A. M. Williams,¹⁴ in developing a new interpolation formula for the adsorption of gases, calculated the surface of the non-activated charcoal used by Miss Homfray as 131 square meters.

The data given in the preceding section of this paper, together with the equations given there, suggest an independent method of determining whether these estimates are of the right order of magnitude to represent what may be called the "apparent surface," which will be defined as the area of the plane surface of the same material

¹³ Lowry and Hulett, THIS JOURNAL, 42, 1393-1419 (1920).

¹⁴ A. M. Williams, Proc. Roy. Soc. Edinburgh, 39, 48-55 (1918).

which will give the same heat of immersion or of wetting when wet by the same liquid in bulk. Unfortunately for our purpose the heat of adsorption of charcoal has been determined in none of the liquids given there, so what will be presented here will be merely illustrative of the method. We will suppose that the heat of immersion of charcoal in carbon disulfide is as large or larger than the heat of immersion of mercury in octane, which does not seem unreasonable. If we assume that these two heats of immersion or of wetting are equal, the heat of immersion of one gram of charcoal in carbon disulfide, 35 calories, would correspond to an *apparent area* as defined above of about 120 square meters. Since it is practically certain that the heats of immersion of carbon are higher than those for mercury, this result would seem to represent a maximum which is still too large. The method of calculating the area of the charcoal surface by the use of the capillary equation of Anderson¹⁵ cannot be expected to give any real correspondence with even such an apparent area, since his equation obviously breaks down completely at the diameters of the micropores which are calculated from the equation. Thus Lowry and Hulett¹³, by using his equation, find 1.6×10^{-8} cm. as the minimum, and 8.3×10^{-7} cm. as the maximum diameters of the pores in all of the charcoals investigated by them; and calculations from data obtained in this laboratory give values of the same order but without the above minimum. These dimensions are of such a small magnitude as to approach so closely molecular dimensions, that an equation such as the one cited, developed from the relations in a capillary tube of ordinary dimensions, is altogether without meaning. However, if the lower limits for the diameter at which it is still valid could be determined, it would be useful in calculating how much of the liquid is contained in pores of that and smaller diameters. Experimental work of the heat of immersion of porous solids in liquids was begun in this laboratory several years ago, but was interrupted. It will be resumed in the coming summer.

6. VOLUME OF THE PORES, AND THE DENSITY OF CHARCOAL.

If either charcoal E 602 or No. 1, for which the data are very nearly identical, is

taken as a characteristic coconut-shell charcoal, it may be easily seen that if the liquids are compressed by the charcoal, the total pore volume is less than even the volume of the least compressible liquid which enters the pores, when the latter is measured before the penetration occurs, as was done in the experiments. Thus the total pore volume for E 602 is less than 0.534 cc. per cc., and in the case of No. 1 it is less than 0.533. Since the macropores have diameters of the order of 1.2×10^{-3} cm., it is evident that in them the liquids are not materially compressed, so practically the whole of the compression occurs in the micropores.

Experiments upon the adsorption of benzene show that these charcoals adsorb about 0.39 cc. of liquid benzene, 0.35 cc. of water, 0.41 cc. of ether, etc., as measured before adsorption. From this result, together with the data on the adsorption of liquids, it may be calculated that the volume relations for these charcoals are approximately 0.54, 0.28 and 0.18 for the volume of carbon (volume not occupied by liquid), volume of micropores, and volume of macropores, respectively.

These values give a density of 1.60 for the active charcoal. It may be noted that the two specimens of wood charcoal which showed almost no compressive action on the liquids, those from beech and cedar wood, had densities equal to 1.65 and 1.50 respectively, or not far from the estimated value for the carbon in the coconut-shell charcoal.

While Table I. does not give any values for liquids whose percentage compressions have been determined directly at 12,000 atmospheres as lying between that of propyl alcohol and that of carbon disulfide, the determinations on the compressibility of liquids at lower pressures indicate that chloroform, benzene and *p*-xylene are in the proper order. Mr. Monroe's paper will remedy the apparent deficiency, since he has determined the pore volumes for 5 liquids which lie in this range; amyl alcohol, *iso*-butyl alcohol, ethyl iodide, and ethyl and methyl alcohols. His results give extremely strong additional evidence in favour of the compression hypothesis here presented.

7. THE SMALL EFFECTS OF THE SIZE OF THE MOLECULES, AND OF UNEQUAL ADHESIONAL ATTRACTIONS.

Calculations made on the relation between the lowering of the vapour pressure produced by charcoal and the size of the micro-

¹⁵ Anderson, *Z. physik. Chem.*, 88, 191 (1914).

pores indicate such small dimensions for the latter as to suggest that the size of the molecules might be an important factor in determining the amount of liquid which will enter them. This idea occurred to the writers early in the work, and was suggested to them repeatedly by others. However, although a number of liquids were chosen with the purpose of varying the molecular size considerably, this effect is not so large that it has been possible to detect it as yet. In this connection a determination of the pore volume was made with mesitylene, a liquid whose molecules are very large. For the liquids used the values of b of the van der Waals' equation varied from 14×10^{-4} for water to 88×10^{-4} for mesitylene, which indicates a considerable variation in molecular size. Also it would seem that the force of compression might vary with the nature of the adsorbed liquid, which would indicate that the percentage compressions considered should not be taken at a fixed pressure as was done in Table I. It is evident from the data published here, and even more so from other data to be published later, that these two effects considered in this paragraph are so small as to be obscured by the compression itself.

SUMMARY.

1. This paper gives evidence in favour of the hypothesis proposed earlier by the writers, which is that *the liquids which penetrate into charcoal are compressed by the action of a force, due to molecular attraction, which acts as a pressure of many thousand atmospheres.* In the earlier paper it was estimated that the pressure corresponded to twenty thousand atmospheres or more. The present paper indicates that it is the liquid in the micropores and not in the macropores which is compressed. On this basis the pressure would probably be considerably higher than the previous estimate, since at that time only the total pore volume was known and considered. Not only charcoal, but also all other porous substances, such as porous ceramic materials, and also very fine powders, should exert this compressive effect, but in general to a much smaller extent. The remarkable feature of the experiments listed is that they demonstrate the compression by direct measurements of the volume changes in the liquids. Experiments on the internal pressure of liquids have not succeeded in demonstrating pressures higher than 72 atmospheres.

2. Ether, which is much more compressible than water, occupies a volume in the charcoal which is about 10% less than that occupied by the amount of water which is, outside the charcoal, equal in volume to the ether. It seems probable that the water in the micropores is compressed by about 25%, or even more, while the ether is compressed by about 40%. It is evident that the liquids in the macropores, of the order of 1.2×10^{-3} cm. in diameter, are not compressed sufficiently to produce any noticeable effect upon the volume.

3. The true volume relations in 1 cc. of a characteristic coconut-shell charcoal may be estimated as: volume of micropores, 0.28 cc.; of macropores, 0.18 cc.; of carbon, 0.54; which gives a density of about 1.60 for the carbon. The density of the lumps of such a charcoal is about 0.868, though this lump or "block" density is as high as 1.49 for a charcoal made from anthracite coal, and as low as 0.52 for a wood charcoal.

4. The charcoals which are inactive as adsorbents of gases do not exert a compressive effect upon the adsorbed liquids of a sufficiently great magnitude to be very evident, though there seems to be a slight effect of this nature.

5. The densities of the carbon in the two inactive wood charcoals investigated are 1.65 and 1.50, which is not very far from the estimated density for the carbon of the active charcoals. It is evident that charcoals from which the hydrocarbons have been imperfectly eliminated may have much lower densities still.

6. When coconut-shell charcoals alone are considered, it is found that in agreement with the data obtained by Chaney and Apmann, the lower the apparent density in an organic liquid, the less is the adsorptive action on vapours. The present investigation indicates that this relation may be expected to hold the better the more compressible the liquid which is absorbed, so either ether or pentane or another highly compressible liquid should be used in such tests.

7. Simple thermodynamic equations are given for the heat of immersion or adsorption of a plane surface. While there is probably no definite area of surface inside a lump of charcoal, a definition for an "apparent area" may be given. The one chosen here is that the "apparent area with respect to the heat of immersion" is the area of the plane surface of carbon which

will develop the same amount of heat on immersion as is equal to that developed by the immersion of 1 g. (or 1 cc., if such a different unit is preferred) of the charcoal in the same liquid. Since the "film" in the charcoal is probably a number of molecules deep, this apparent area is probably larger than corresponds to the carbon surface. Nevertheless, this method of consideration gives rise to a lower estimate of the area than the others which have been given in the literature. Thus it is indicated that the apparent area defined in this way is less than 120 sq. meters per gram of charcoal.

8. The magnitude of the heat of immersion of liquids on mercury is 3.13×10^{-6} calories for octane and 3.25×10^{-6} calories per sq. cm. for *iso*-butyl alcohol.

The next two papers of this series will present additional data similar to those given here, and also on the amounts of different vapours adsorbed by the charcoals used in this investigation. These data will make it possible to calculate in much more detail the pressure and cohesive relations involved.

The writers wish to thank Mr. Chaney for preparing several special charcoals for use in this work, and to express their indebtedness to the Wolcott Gibbs Fund of the National Academy of Sciences for a grant which was used in the purchase of vacuum apparatus. While the grant was

made for researches upon the cobalt amines, the apparatus was diverted from this latter work during the war period.

The compressibility data used in this paper are those of Bridgman.¹⁶ Without the results of his remarkable investigations at high pressures, the evidence in favour of the compression hypothesis developed by the writers would have been much less convincing.

Note added Oct. 26, 1921.

Washburn¹⁷ has devised a method for determining the "true" volume of the pores in a ceramic material by the use of a gas, such as hydrogen or helium, as the liquid for filling the pores. This method has been tried in this laboratory, and has been found to be much less simple when applied to charcoal, but it will undoubtedly give consistent results when sufficient care is taken. The data obtained thus far will not be published until they are more carefully verified. With accurate data of this nature it may be possible to calculate more exactly the pore volume and the density of charcoal, though, on account of the small size of the molecules of helium the volume of the pores penetrated by this gas may be greater than that penetrated by the larger molecules of an organic liquid. Also it seems apparent that even at ordinary temperatures the density of the helium gas is not the same in the micropores as in the free gas, that is, there is a small amount of adsorption.

CHICAGO, ILL.

16 Bridgman, *Proc. Am. Acad. Arts Sci.*, 49, 3-114 (1913); 48, 309-362 (1912).

17 Private communication from Professor E. W. Washburn. Note added October 26, 1921.

SUBSTANCES DISSOLVED IN RAIN AND SNOW.

By SHERMAN SHAFFER.

The determination of the character and quantities of the substances dissolved in rain and snow is of considerable interest and importance. My work is a continuation of the rain and snow analyses which have been made at Cornell College for a number of years.

The samples for analysis were collected in enamelled ware pans, at an open spot near the centre of the village of Mount Vernon, Iowa. Mount Vernon is a town of about 2,100 population, situated seventeen miles from a manufacturing centre, and with no industries of its own. The samples were analysed as soon as possible after they were collected. They were analysed under ordinary laboratory conditions, but every precaution was taken to ensure that no contamination should take place.

Forty-five samples of rain and snow were

analysed during the period from August 18th, 1920, to June 1st, 1921. The precipitation during this period was 20.97 inches, 18.14 inches of rain and 34 inches of snow. Twelve inches of snow are taken as equal to one inch of rain.

The nitrates which fell during this period amounted to 0.60125 pounds per acre, assuming that one inch of rain on an acre weighs 226.875 pounds. The average content was 0.3 parts per million. The highest nitrate content was 1.0 part per million on January 4th, 1921. The amount of nitrates is influenced by the length of the interval between rains. A curve drawn between intervals between rains as abscissa and nitrates per inch of rain as ordinates tends to rise as the interval is increased. There is no noticeable variation of the amount of nitrates with the seasons. On the contrary, the average through the year is quite constant. When the amount of nitrates per inch of rain for each month is compared with the rainfall in inches for each month, it is found that the nitrates per inch are greater

when the rainfall is less; that is, the solution is more concentrated, as might be expected. When the nitrates are determined by the phenolsulphonic method and no sodium carbonate is added before evaporation of the water, very little nitrates is found. This would seem to indicate that all the nitrate is in the form of free nitric acid. If this is true, the ammonia present must be united with some other acid radicle or it would unite with the nitric.

The nitrates totalled 0.03985 pounds per acre. The highest figure was 0.05 parts per million on April 17th, 1921. The average was 0.03233 parts per million. A curve between time interval between rains and nitrites per inch of rain showed an increase with an increasing interval, but the curve was very irregular. The nitrites, like the nitrates, tended to greater concentration when there was less rain, but the tendency was not so marked as in the case of the nitrates.

The total amount of free ammonia was 1.48045 pounds per acre. The highest ammonia was in the snow of November 27th, 1920, which tested 2.1 parts per million. The average was 0.67 parts per million.

On the whole, no difference was found in the amounts of substances dissolved by snow and rain under the same circumstances. This differs from the results of former investigators, who found that snow did not ordinarily carry down as much of the substances found as did rain.

The albuminoid ammonia amounted during the period to 1.16022 pounds per acre. The highest was 2.0 parts per million, on December 13th, 1920. The average was 0.3 parts per million, considerably less than the free ammonia. A curve drawn between albuminoid ammonia per inch of rain and time interval between rains shows a very striking increase of ammonia with increase of time interval. The albuminoid ammonia remained on the average fairly constant throughout the year, as did the free ammonia. Both were lower in the spring than during the fall and winter.

A total of 34.43179 pounds of chlorides per acre were found. The average chlorine content was 10.1 parts per million. The highest was 49.7 parts per million. The chlorides were higher during the winter and spring than during the fall. They were not found to be present in constant proportion as was found by former investigators, but varied from 3.5 parts per million to 49.7. The chlorides show the same tendency as the other substances to be more concen-

trated when the rainfall is less. A curve drawn between chlorides and intervals of time between rains shows an increase in chlorides with the increase in time interval.

Former investigators have attributed the presence of chlorides in rain and snow to the salt spray of the ocean, whipped up and borne away by the winds. We questioned this source, in view of our great distance inland, and undertook a series of analyses of the chlorides found in rain water. The method employed was to evaporate five to ten litres of rain water, carefully excluding all laboratory dust, and determine the proportion of sodium and potassium present by the chloroplatinate method. The analyses gave such varying results that we conclude that the source of the chlorides is not the ocean spray, at least, not to any great degree. Such a source, according to the published analyses of sea water, would supply a large preponderance of sodium over potassium salts, while the reverse was found to be the case in some cases. This would imply that the true source of these chlorides is to be found in the fumes from industrial plants, the greater quantities of potassium being explained by the more volatile nature of its salts. Another source which has been suggested is the dust from the Western deserts of the United States, which is known to be carried great distances by the wind, and which would doubtless be alkiline in nature.

The total sulphates amounted to 102.08035 pounds per acre, figured as SO_3 . The average was 29.9 parts per million, and the highest 101.2 on May 17th, 1921. The very large amount of sulphates found is probably due to the cheap grade of coal which the high prices forced consumers to use. The sulphates found rise from none in August to 66.2 pounds per acre in February, after which they again decline.

Thirteen determinations of sulphurous acid were made, using N/10 iodine-potassium iodide solution against N/10 sodium thio-sulphate solution. Seven of the tests showed none present. The average of the other tests was 1.43 parts per million. The highest was 1.8 parts per million on May 17th, 1921.

The total nitrogen which fell in all forms was 3.28178 pounds per acre. This was divided as follows: as nitric acid, 5.74 per cent.; as nitrous acid, 0.51 per cent.; as ammonia, 93.73 per cent.

Grateful acknowledgment is made of the kind assistance and suggestions of Dr. N. Knight in carrying out this work.

MINISTRY OF AGRICULTURE AND FISHERIES.

(Ministry of Agriculture and Fisheries
Leaflet No. 383.)

HINTS ON GOAT-KEEPING.

Smallholders, agricultural labourers, allotment holders, cottagers and others who have surplus vegetable material from gardens or allotments, or who have access to cheap grazing or to supplies of wild green food, will find it useful and economical to keep a milking goat, especially if any difficulty is experienced in obtaining regular supplies of fresh cow's milk.

The initial cost of a goat is small, and the necessary housing is inexpensive. Any small shed will serve so long as it is clean, dry, light and properly ventilated.

A milking goat of ordinarily good quality should yield, under proper management, from 70 to 100 gallons of rich milk in a year. A first-class animal will give double this quantity, and will probably cost no more to keep than a poor milker.

When buying a goat the purchaser should satisfy himself as to its milk yield, preferably by seeing it milked. A goat which gives less than two quarts a day within a few weeks after its second kidding is hardly worth keeping.

It is *not* essential that goats should be turned out to graze. A milking goat may be fed in its shed all the year round, provided it be given sufficient exercise and be supplied with the necessary variety of food.

A milking goat costs very little to keep. It will thrive on vegetable waste from the garden or allotment, and on hedge trimmings, acorns, and such weeds as dandelions, sow thistles, docks, young nettles, etc., with the addition of a little bran, oats or cattle cake. A small allowance of hay is required in winter. Yew and rhododendron leaves are poisonous to goats.

Goats will eat almost anything, but will do damage to fruit trees and hedges if not kept under proper control. They should never be let loose in gardens.

Goat's milk is rich in fat and albuminoids, and is usually remarkably free from tubercle bacilli. It is very digestible and is particularly suitable for invalids and children.

There is much misunderstanding as to the flavour of goat's milk. If a goat is kept properly and given suitable food, as described above, its milk is equally as palatable as cow's milk.

Further information on the subject of goat-keeping is given in Leaflet No. 306 (*The Goat as a Source of Milk*), single copies of which may be obtained free of charge and post free on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

NOTE ON THE MODIFICATION OF DUANE'S APPARATUS FOR PURIFICATION OF RADIUM EMANATION.

In 1915, Professor Duane¹ published a method for the purification of radium as collected from aqueous solution, without the use of liquid air. Collection was effected by mercury displacement by means of a system of glass bulbs which acted as an internal pump. In order to remove oxygen and hydrogen from the gaseous mixture, the gases were passed over an electrically heated, partially oxidised copper wire. The glowing wire causes the hydrogen and oxygen to unite, and the excess of hydrogen is reduced by the copper oxide. The water-vapour formed is removed by a side tube containing P_2O_5 . The disadvantage in using an oxidised copper wire as the heating body is twofold. On account of the low resistance of copper, a rather high current, 10 to 15 amperes, must be used initially. As the gas pressure diminishes, the current must be correspondingly diminished in order to avoid overheating of the copper wire.

The modification in the furnace consisted in utilising a platinum wire instead of copper. This has a double advantage in the high melting-point of platinum, and its high resistance. About 5 feet of No. 32 wire was wound on a small rod of silica 5mm. in diameter and 15cm. long. This was then incased in a thin tube of transparent silica fitting snugly over the spiral coil. It was found that sufficient heat was conducted through the quartz tube to raise an oxidised copper ribbon, wrapped spirally outside of the quartz tube, to a sufficient temperature to cause hydrogen to be reduced. By this indirect heating of oxidised copper the temperature was controlled so that there was no danger of overheating the copper, and a very low current, 1 to 3 amperes, was sufficient. Such a furnace was satisfactory for a period of nearly a year without renewal. The copper had to be re-oxidised from time to time, as in the original Duane apparatus.

GENERAL NOTES.

We have received from the Editor of Publications, Department of Industries, Government of India, the *Journal of Indian Industries and Labour* for November, 1921. It is a well-printed journal of some 150 pages, containing a number of interesting original articles. Amongst others we notice articles on Smoke Prevention and Fuel Economy, Modern Paper-making, Handloom Weaving, Mangrove Swamps, Industrial Disputes, together with summaries of industrial intelligence from Assam, Bengal, Madras, and other provinces.

The journal is published by order of the Government of India, and can be obtained from any prominent publisher in Europe.

DEMAND FOR REDUCTION OF COMMERCIAL MOTOR TAXATION.

The National Council of the Commercial Motor Users Association, Incorporated, will at its next meeting, to be held in London on the 1st February next, consider a motion from its London and Home Counties Division in favour of the necessary steps being taken to endeavour to secure at least a one-fourth all round reduction of motor taxation in the next Finance Act.

The Editor of the *Blackpool Times* has sent us a copy of their issue for 6th January, 1922, containing a number of illustrations produced by the photo-litho offset process, and it is claimed that this is the first newspaper in Great Britain and Ireland containing illustrations produced by this method.

The pictorial effect is very good. A view of Bispham Parish Church with its surroundings is a very creditable production, but other photographs, particularly the full page of the local parliament, leave very much to be desired; the faces of the gentlemen present are very lacking in detail, and the general effect of the chamber is rather startling. In all probability, however, the pictures will be improved upon in future issues.

We have received a proof of an important paper read on the 12th inst. before the Optical Society, on the manufacture of Optical Glass, by C. J. Peddle, M.B.E., D.Sc., F.I.C., F.Inst.P.

The paper deals exhaustively with the manufacture of optical glass, from the early

work of Faraday, Herschel, Dollond and others, down to the present day.

The importance of this manufacture was brought home to all of us during the great war, and it would be a calamity if the knowledge gained under that impetus was not followed up. Dr. Peddle's paper is very fully illustrated, contains a mass of experimental detail carefully described, and is a valuable contribution to our knowledge of the subject.

MINISTRY OF AGRICULTURE AND FISHERIES.

INSECTICIDES AND FUNGICIDES.

A Bill has been drafted for the regulation of the trade in certain of the chemicals most generally used for the control of pests. Certain of the more important provisions have been published in the form of a pamphlet for the use of the public and for manufacturers, and specifications are given for the following substances:—Lead arsenate paste, lime-sulphur, nicotine, copper sulphate, soft soaps, sodium and potassium cyanides, formaldehyde, and liver of sulphur.

Copies of the leaflet No. 363 may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

THE ROYAL SOCIETY OF ARTS.
LECTURES ON "THE MIND."

A series of eight lectures, arranged by the People's League of Health, 12, Stratford Place, W.1, is to be delivered at the Royal Society of Arts, John Street, Adelphi, on Mondays in February and March, at 6 p.m., on "The Mind and what we ought to know about it." The subjects and lecturers are as follows:—"Primitive Instinct" (Dr. Bernard Hart), Feb. 6; "Sensation, Perception, Ideation, and Attention" (Dr. R. H. Cole), Feb. 13; "Association of Ideas, Recognition, and Memory" (Dr. R. S. Rows), Feb. 20; "Habit Adaptation" (Sir Maurice Craig, M.D.), Feb. 27; "Fatigue and Sleep" (Sir R. Armstrong Jones, M.D.), March 6; "Mind and Body" (Sir F. Mott, M.D.), March 13; "Crime and Delinquency" (Dr. W. A. Potts), March 20; "Mental Deficiency" (Dr. Tredgold), March 27.

Professor J. A. Fleming, Professor of Electrical Engineering in the University of London, delivered the last of a series of

Christmas lectures on electric waves and wireless telephony at the Royal Institution yesterday afternoon. The lecture was illustrated by numerous diagrams and lantern slides, as well as by many fascinating experiments, the uniform success of which was no doubt the reward of long and careful preliminary preparation.

The feature of the afternoon was the transmission by wireless telephone from Marconi House in the Strand of several musical items, which were reproduced with remarkable clearness and made audible to everyone present, by means of a stentorphone in the lecture hall. The first was a gramophone record of "Rule, Britannia," played by a band, the second a song, and the third a violin solo by Kreisler. In addition, the Duke of Northumberland transmitted the following message to the audience:—"As President of the Royal Institution I take this opportunity of sending my heartiest greetings for the New Year to the audience which is now gathered to listen to Professor Fleming.

OBITUARY.

EDWIN JOHN DAVEY.

With very great regret we have to announce the death in his 78th year of Mr. Edwin John Davey, who for nearly forty-five years was responsible for the printing and publication of the *Chemical News*. Mr. Davey practically devoted the whole of his time to the work of the paper, and during the life of the late Sir William Crookes was mainly responsible for all the details of publication. He felt the death of his old chief keenly, and for some time past has been failing in health.

ROYAL SOCIETY.

List of probable papers for reading on January 26:—

W. B. Hardy, Sec.R.S., and Ida Doubleday—Boundary Lubrication—The Paraffin Series.

Prof. W. A. Bone, F.R.S., A. R. Pearson, E. Sinkins n. B.Sc., and W. E. Stockings—Researches on the Chemistry of Coal. Part II. The Resinic Constituents and Coking Propensities of Coals.

J. A. Crowther, D.Sc., and B. J. Schonland, B.Sc.—On the scattering of B rays. Communicated by Sir Ernest Rutherford, F.R.S.

Ann C. Davies—The Minimum Electron Energies associated with the Excitation of the Spectra of Helium. Communicated by Sir Ernest Rutherford, F.R.S.

C. N. Hinshelwood, H. Hartley, and B. Topley. The Influence of Temperature on two Alternative Modes of Decomposition of Formic Acid. Communicated by Professor J. W. Nicholson, F.R.S.

C. V. Raman, D.Sc. On the Molecular Scattering of Light in Water and the Colour of the Sea. Communicated by Dr. G. T. Walker, F.R.S.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

ANNUAL GENERAL MEETING.

The annual general meeting of the society will be held on Wednesday, February 1st, at the Chemical Society's Rooms, Burlington House, Piccadilly, W., at 8 p.m.

The accounts for the year will be presented, the President will deliver his annual address, and the election of officers and Council for the ensuing term will take place. The appointment of Auditor will also take place.

The ordinary monthly-meeting of the society will be held immediately following the annual general meeting, when the following papers will be read:—

"Studies in the Titration of Acids and Bases." By J. L. Lizius, B.Sc., A.I.C., and Norman Evers, B.Sc., F.I.C.

"The Sulphuric Acid Reaction for Liver Oils and its Significance." By J. C. Drummond, D.Sc., F.I.C., and A. F. Watson, B.Sc., A.I.C.

"The Quantitative Separation of Nitrobody Mixtures from Nitro-glycerine." By William Dickson, F.I.C., and W. C. Easterbrook.

INSTITUTE OF CHEMISTRY.

The London and South-Eastern Counties Section of the Institute of Chemistry will hold an Exhibition of Apparatus other than glassware in the Laboratories of the Institute on Wednesday, January 25th, from 6 p.m. to 10 p.m.

GERMAN REPARATIONS IN KIND AS AFFECTING BRITISH ENGINEERING INDUSTRY.

It is stated in the Press that important Ministerial conversations are taking place

in regard to the German reparations and the feasibility of our accepting part payment thereof in kind.

Furthermore suggestions have been made in the Press and elsewhere that such part payment in kind might take the form of the supply by Germany of the machinery, plant and other equipment for a number of large electric generating stations—so called super power stations—and for electrification of railways in Great Britain.

The British Engineers' Association takes the strongest possible exception to the above mentioned suggestions. The objections to this procedure are fully stated in a letter which has been addressed to the Prime Minister by the Director of the Association, Mr. D. A. Bremner.

A copy of the letter has also been forwarded to the Federation of British Industries.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks and Designs can be obtained gratuitously.

Latest Patent Applications.

- 35062 Bloxam, A. G. Colloidal-chemical processes for purifying substances. Dec. 30.
- 34955 Cassella & Co. L. Vat dyes-stuffs. Dec. 29.
- 34991 Cook, D. Chemical and/or physical synthesis. Dec. 30.
- 35064 Geis and Farbstoffwerke, H. Manufacture of salts of sulphonated coumarone resins. Dec. 30.
- 34970—Nobels Explosives Co., Ltd.—Manufacture of hydrazine. Dec. 29.
- 34888 Salferink, W. R. Purification of ferro-alloys of refractory metals. Dec. 28.
Specifications Published this Week.
- 148,139 Bucherer, Dr. H. Process for the production of derivatives of condensation products of formaldehyde and phenols.
- 172,688 Schriener, G. Hydrogenation of naphthalene.
- 161,553—Lipman, G. J.—Culture of sulfur-oxidizing bacteria and their application.
- 172,558—Hargreaves, L.—Manufacture of sodium thiosulphate.

Abstracts Published this Week.

Antiseptics. Patent No. 171,418. Some new methods of preparing antiseptics, particularly chloro-phenols, have been invented by Mr. W. H. H. Norris, of 20, Church Lane, Prestwick, Lancashire.

The compounds are prepared by chlorinating the sharp oil produced by removing phenol, cresols, and xylenols from coal tar or blast-furnace tar cresote oil; the sharp oil contains phenolic

bodies of high boiling point. The chlorination may be effected by means of chlorine, or a compound thereof, such as sodium hypochlorite or sulphuryl chloride; preferably the sharp oil is dissolved in a solvent such as carbon tetrachloride. From 80 to 140 per cent. by weight of chlorine is introduced in stages at progressively increased temperatures. The products may be rendered soluble or miscible with water by means of alkali; alone or with addition of emulsifying-agents, such as mapthenates, soaps, resin soaps, sulphonated fatty oils or acids, casein, gelatine.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on post free for the official price of 1s. each

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3224.

SIGNS OF A TRADE REVIVAL.

FOREIGN MISSION OF A WELL-KNOWN MANAGING DIRECTOR.

Note from the Manager, Publicity Department, Industrial League and Council.

January 17th, 1922.

Numerous references have been made of late to incidents which point to the fact that a revival in trade is gradually assuming definite shape, and although to the average individual nothing tangible is visible, it is evident that there are grounds for the optimism that has led to public utterances on the subject by many prominent men. While big financiers are regarded as the men who know, since it is their business to be able to interpret the meaning of the vasculations of the market, it is proverbial that the great manufacturers, who, metaphorically speaking, have to understand the pulse of industry, are in a more favoured position in regard to foreseeing the trend of events, and it is significant that of late many have taken steps to put their house in order as though to welcome a belated guest.

In many cases the managing directors of firms have, notwithstanding the activities of their representative men, stepped once again into the arena of foreign agency in order to give added impetus to the immediate prospects of industrial revival, and a notable instance during the week end was the departure of Mr. E. W. Petter, Chairman of the British Engineers Association and a member of the Executive Committee of the Industrial League and Council, for India.

Mr. Petter is sailing to Bombay by the *Macedonia*, which left London on Friday, but he personally left town on Saturday, travelling overland to Marseilles, where he joined the boat on Monday, the 16th inst. He intends to make a complete tour of the important Indian centres, taking in Bombay, Madras, Calcutta, Delhi, Lahore, etc., and anticipates returning early in May.

Regardless of the much vaunted aggression of German industrialism contingent

upon the depreciation of the Mark and the appreciated position in the world's markets, from a competitive standpoint, of her manufacturers, the tentacles of the industries of Great Britain are slowly but surely gaining a hold in all the vital markets of the world, and just as soon as the orders now being negotiated reach our workshops and factories, so will the wheels of industry commence to revolve in this country.

RELATIONSHIP BETWEEN CALCIUM AND STRONTIUM.

To the Editor of the *Chemical News*.

Dear Sir,—Several months ago, you published a note called "An Extraordinary Relationship between Calcium and Strontium." Subsequent inquiry showed that the title was justified, because the relationship at this position of minimum deviation is a theoretical one. Not only so, but also there are reasons for believing that there is no number other than 2878, which is itself a four. The reasons are the following:—

1. There is a real relationship between the elements of group IIA and those of group VIII, which has been discovered by the author:—

$$1 - \text{Sr.} = 2 \times \text{Fe} \times \log_{10} 1,290.$$

So that calcium on the one system, and iron on the other, which are represented by approximately the same number, are also both related through strontium, in a fundamental way. This by itself would justify the use of the four figure number, without the addendum. Similar arguments would treat of other fifth place ciphers.

2. The logarithm of the reciprocal of the Barium product ($\text{Bd} = 98631$) — 02 is cobalt — 018.4 $\log_{10}$ 1878 being 27184 + 00184.

This connection being further justified by the fact that the product corresponding to the $\log. - 02$ contains the same ciphers as the Ba. number itself = 26831. The corresponding $\log.$ and reciprocal being 1/7 and the atomic weight of mercury on a very important system of units (which will be established later) 863 = 8Ag.

3. 1878 with addenda can exist as an integral portion of a number with the addendum determining the precise nature of the association. For example: 18786×2

$= 37572 \log 27572 = 44015$ $27572 = 2 \times 13786 = \log$ of $13786 = 16$. If now $\log 13786 = 15.44$ is made diatomic ($3944 = 2 \text{ Au}$), in the relation $1/1 = \log, x/1$, $1365 = x$ i.e., $= \text{P}$. $\text{Cl} = 2546$, and the difference between the value of x and the anti-logarithm $= x$, while $1352 = x \log_{10}$ of 1365 when $1 = \text{Te}$, and the anomaly of the periodic system removed. Since $1972 = \text{Au}$, it would not be unreasonable to assign the value 27571 to Ag , F . remaining 13736. The correct equivalent of F . is 4800, $\text{mol log} = 4800$, $8651 = 8 \text{ Ag}$. The sum of the values is 62298, the number following the six is probably 22983, which is a very important numerical association. The difference is 34829. The number without the first cypher is the atomic weight of Cl . on a system of units obtained by interchanging silver and selenium with respect to the multiplicand 1106. $\text{Ag} \times \log_{129} = \text{Sn} +$. And on the same system $\log_{129} \text{Sn} = \text{Cl}$. and sulphur and chlorine are also number and logarithm to the Napierian Base. The sum of the values of Ag . is 10535. The property of Au . F . is, as it is well known, anomalous, as also that of Ca . F . with respect to its solubility in water. It is near the position of minimum deviation that this happens.

4. As a further illustration of this type of relation, take $\text{Se} = 7642 = 35284 \div 2 - 1$. $\text{Fe} = 10784 \div 2$, $\log \text{Au} = 5588 \div 2$. But when $\text{Ca} = 4013$, leading to 2×15326 $\text{Au} = 1326$ and $\text{Fe} = 2 \times 1878$. $\text{Na} = 4 \times 3617$. It is possible that all these numerical associations are operated upon by some new function of numbers, and that four plays an important part. For example, 4829, which is called a four function, has the following associations:— $34829 \rightarrow 13829 \sqrt{13829} = 37187$, $\sqrt{3829} = 61879$. $34829^2 = 2 \times 6065$. $\log 4041 = 6065$. $4041 = 6357^2$. $\sqrt{174145} = 4173 = 1114 + 0029$. $3546 = 6357 = 7189$. $4404 - 405 = 0354 \rightarrow 10849 \rightarrow 12159$. $4404 \cdot 12159 = 3622$. $64385 = 0849 = 55895$ (Fe . Co .); sum = 72875 $\rightarrow 53548$. There seems to be a tendency from strict mathematical relationship, which realises itself through other subsidiary relationships between substances. The best method to adopt under the circumstances is to arrange the atomic numbers as "coefficients" of 1878, and to suit any particular association $\text{Ca} = 28755$. $\text{Sr} = \log_{10} 4009$. Product by adjusting the fifth place. For example,

$$35302. \log 3503 = 54444. \quad 3503/2503 \times 23026 = 32222.$$

The following are several coefficients:— Co . 22545 $\log_{10} = 35306$. $\text{Mn} = 21 \log = 32223$. $\text{Ca} = 15327$. $\log = 18546$. $\text{Na} = 87933$. $\text{C} = 45584 \log = 66166$. $\text{Si} = 1082$; $\log = 03422$ (27377).

Aluminium and gold coefficients:— $\text{Cl} = 2546$. $\text{Au} = 75393$, $\log \text{Al} = 015393$. This is the position of minimum deviation, and is in parallel with $\text{Zn} = 65394$ 27183. Aluminium, gold and zinc are not in the same group. The aluminium-gold-relation persists for a certain range of values, and in other regions the deviations are comparable to the values themselves.

$\text{Au} = 21000 \text{ Al} = 28868 \log$. coef. $\text{Al} = 04283$. coef. $\text{Au} = 80286$.

$\text{Au} = 3911 \text{ Al} = 53763 \log$. $\text{Al} = 3129$. Coef. = 2055 $\text{Au} = 14952 \text{ d} = 2052$.

$\text{Au} = 792 \text{ Al} = 1089 \log$. $\text{Al} = 03692$. Coef. $\text{Au} = 3027$. $\text{Au} = 41623 \text{ d} = 404$.

5. With the aid of these coefficients the relationship between Gp. IIA and Gp. VIII . is extended to nickel, manganese, and magnesium. This must be preceded by the establishment of another system of units, which is done very simply. Let Ca . approximately 1145. $2145 \times 4 = 858$. $\log x 758^2 = 1145$. $\log_{10} x = 858$. Let Br ., 858

which is approximately twice Ca ., be 2283. Then the value of Ca . becomes exactly the one to render the square relation, accurate to the fifth place. $\text{Pb} = 5916$. $\text{Mn} = 15691$. $\text{Ag} = 30816$.

The manganese coef. is 21. Nickel 22434. Let $\text{Cl} = 22432$. $\text{Zn} = 41353$. Calculating S . on Mg . 22432 gives 2958 = $\text{Pb}/2$. $\log 22432 = 5691$. $x = 41353 = \text{Zn}$.; for a short range of values the differences between the radices obtained in this way from 41353, and those of Pb . from 5916 are proportional. The position of minimum deviation is thus related to the whole number 21 Mn ., which would control deviations. If the same operation is performed on 22434, then Zn . and the radex differ, $r = 41339$, $\text{Zn} = 41357$; but $\log_{10} x = 61632 = 2 \text{ Ag}$. And 61632 is a fragment of a serial $2433^x = 2433 \dots x = 53286$. Ca . coef. = 15327. $\log_{10} 3887 = 5896$. $\log_{129} 3887 = 5329$. The serial 243589 is completed with 616362

if Mg. is equated to consecutive portions of the serial, so that two portions have one or more ciphers in common (and correcting for chemical equivalent, *e.g.*, Mg. = 2436, Mo. = 9615). The serial as a fraction = 2×7083 . 2 Mn. = 31386 is also a fragment of the complete log. 129 11063138666. Again, 2434, corresponding to 1878, is an important value. When Na. and 15322, which is the characteristic number of *e*. (and which has been derived by the writer entirely from base 10), are made equal in face value, Na. = 298, 15322 = 1985, iron and sodium, which were before only approximately related, now become exactly related. Log.₁₀ 362 = 5587. Fe. = 7236 = 3618×2 . In a similar manner let Mg. and 15322 be equalised, then Mg. = 28571 ($1/7$) Ni. = 68937. log. *x* 2432 = 34463. *x* = 12941. Log.₁₀ 25882 = 41300 = $2 + 4 \times 5325$. reciprocal $2x$ = log.₁₀ of 2434. $2 \times$ recip. Ni. = 1290124, which is the value of this most important base, derived also from the cube-root of the ratio 8338 and 3883.

6. Referring now to 22983 = $15322 \times \frac{3}{2}$

Log. *x* 2283 = 9. *x* = 32314. Log. (298 $\times 4 - 1$) 192 = 198; *x* = 5 = 32314. It is with the aid of this type of numerical relationship that the relationship between calcium and strontium was extended over a very wide region where squares and logarithms are correlated. Interpolating 9 in 8733 gives the Na. coef. 87933. Log. *x* 8733 = 9. *x* = 5 = 35646, and log. $(793 \times 4 - 1)^2/3172 = 693$. *x* = 17729. 06907 - 84073 - 22833. Log.₁₀ 693 = 84073. 8407 + 356 = 8763. Log.₁₀ 84074 = 92466. 4009 = 45749. If values of Ca. are calculated on Sr. 8407, for given values of Sr. the relation between the Ca. and Sr. products with respect to squares and logarithms extends between the limits Sr. = 35646 and 65581 = $8763/8407 \times 62918$, with the aid of the constant 2663 = $65581 - 62918 (5326/2)$ and whole number multiples thereof, and between 617 and 64 without a constant (numbers in agreement below this limit can be shown to be on a vector). Half the difference between the Ca. product and the square is equal to the Sr. product—the logarithm. This is also the case at the position of minimum deviation, when 101 is used. The limits can be fixed arbitrarily to correspond with those of the method for *e*., for the relation

655 555 23043 (log. 10 27162 4th fraction) between the limits 27083 and 27195. The difference between the strontium product and the logarithm is the same for 35646 as for 6525; product = 27193; and is appr. $526 = 1/19$. With the aid of this number the 129 base is determined. Log.₁₀ 19 = $4 \times$ log. 129 = 72123 = log. $1/19$. Product at 6558 is 27168. For the exact difference of 52493 log.₁₀ Ca. = 230387, there is obtained 1108525 and 129078 and 44025.

The absolute limits are Ca. = 25025. Sr. = 61362. The relation of the Ca. product with log.₁₀ Sr. commencing at 4th decimal place, and values of Sr. are referred to the Ag. fragment. The limits are made to correspond exactly to those of the method for *e*., by interchanging 1 and 0 at the two limits (see Example 5).

Examples:—

1. Sr. = 64. Sr. pr. = 2729. Ca. pr. 34249 $d_{1/2} = 03625$; $d_2 = 03923$.
2. Sr. = 617. Sr. pr. = 2748. Ca. pr. = 34882. $d_{1/2} = 14145$. $d_2 = 1319$. $d_3 = 006655$.
3. Sr. = 616362 Sr. pr. = 27485. Ca. pr. = 34880. $d_1 = 2701$, $d_2 =$ Tellurium = 1275. The serial 61636 is given elsewhere.
4. Sr. = 392. Sr. prod. = 30911. Ca. pr. = 29313. $d_1 = 16348$. $d_2 = 74532$. Subtracting 5326 gives 2127 = 10635×2 .
5. (a) Ca. = 25025. log. Ca./Ca. = 22157. log. 23026 = 3622157. $d_1 = 38832 - 22575 = 15772$; $d_2 = 15721$. 616362 - 52481 = 45775.
(b) Ca. = 2926. $d_1 = 1103$. $d_2 = 2113$. The Ca. sq. = 37095. Ca. pr. $\times 2 = 6996$. Log.₁₀ Sr. = 7878995 and for other values by multiplying the Ca. product by a whole number, *e.g.*, $34953 \times 6 = 209718$. Log.₁₀ Sr. = 7885718 $d_1 = 7683$. Sr. = The fragment - log.₁₀ 6.
6. Subtracting 7782 gives $d_1 = 1043$. $d_2 = 2 \times 10438$ at the limit, multiplying by $K = 23.043$. and $\frac{1}{2}$ 61362 - 20876 = 805.
7. Log 10 = 23026. S = 3206. The change of zero position which is coincident with certain mathematical

relations, is operated upon, by some general law. Let $Sr. = 174 = 2 \times 87$. $Cl. = 7041$. $Ca. = 79606$. A second value for $Sr.$ can be obtained thus: $7401 \rightarrow 8401 - 1599 = 62534 = Sr. Log. 62534 = 79612$ d. from $Ca. = 6$. $Log. Sr. \times Sr. = 44444$. $Log. 274 = 100796$. Similar procedure with $Cl. = 506$ leads to radix 83096. $log_{10} = 8$. $Cl. = 3206$. $Sr. = 16739$. $Sr. = 4143$. $Sr./Ca. = 46184$ (Fe). $Ca. = 36245$. $46184 \cdot 184736$. $log. 7041 = 84703$. $84736 = 71803$. 625431 is a fragment which transforms logarithms from the base 10 to e via the Ca/Sr relation.

8. The strontium product at the position of minimum deviation added to the preceding value of calcium, gives 2 Mn. $27377 + 34009 = 34386 = 2 \times 15693$.

Also 22434 (Ni. coef.) times 256 (log. 94) 87633.

For a value of $Ca. = 42$. Leading to $Cl. = 27147$.

$Sr. = 67087$ $Ca. = 30692$; the sum of $Sr.$ product and $Ca. = 31259$ 2 Mn. Ag. becomes 30691 = $Ca.$

I am,

Yours truly,

A. SAKOSCHANSKY.

PHOSPHATE DEPOSITS OF NAURU AND OCEAN ISLANDS.

An account of the phosphate deposits and workings of Nauru and Ocean Islands, written by the Australian Commissioner on the Board which controls the phosphate business of the islands, and published by the Government of the Commonwealth of Australia, has been received from H.M. Senior Trade Commissioner in Australia, and may be seen by United Kingdom firms interested on application at the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.—*Board of Trade Journal*.

REACTIONS BETWEEN THE HIGHER FATTY ACIDS AND SALTS OF THE LOWER FATTY ACIDS.

BY

ARTHUR W. KNAPP AND RAYMOND V.
WADSWORTH.

This investigation resulted from our discovery of the following fact:—

If finely powdered sodium acetate is added to oils, or melted fats, a jelly or gelatinous precipitate is generally produced.

The dried salt gives more, and the anhydrous salt most jelly. Sodium propionate and sodium butyrate produce similar results. Jellies occupying from one-third to eight-ninths of the volume of the oil were obtained by warming 5 per cent. of the anhydrous sodium acetate with oils consisting mainly of different characteristic glycerides, such as linseed oil, cocoanut "stearine," cacao-butter and olive oil (the oils contained from 0.5 to 2.5 per cent. of acidity reckoned as oleic acid). Castor oil (acidity as oleic acid 1.2 per cent.) gave no jelly. This characteristic action of castor oil has not been further investigated. It would appear either that ricinoleic acid does not decompose the acetate, or if it does, that the soap formed remains in solution.

If the oils are washed with alcohol so as to free them from fatty acids, no jelly is obtained with acetate. That the acetate does not react with the glycerides is also shown by the fact that no acetin is formed. Pure glycerides do not react with sodium acetate, but samples of the following glycerides, which had been prepared six years and hence were slightly decomposed, gave gelatinous precipitates:

tributyryn	trilaurin	trimyristin
tripalmitin	tristearin	triolein

The jellies so obtained are soaps, formed by the intersection of sodium acetate and the free fatty acids. We have here the basis for a new method of removing fatty acids from fats which might prove to have important technical applications.

ACTION OF SALTS WITH FATTY

ACIDS.—It is well known with regard to the fatty acids that the greater the molecular weight the weaker the acid. This is

stated to be well shown, for example, by the marked decrease in the heat of neutralisation. But we find that if the higher fatty acids be put in presence of the salts of the lower fatty acids, the weaker drives out the stronger. The first cause of this reaction is that the salts are soluble in the acids, whereas the soaps form only colloidal solutions. On applying heat the reaction proceeds because the stronger acids are the more volatile, and hence in this respect the action is analogous to the action of sulphuric acid on sodium chloride. Thus if sodium acetate is added to liquid stearic acid, the odour of acetic acid is perceived, and if the mixture is heated to 110°C. for some hours so that the acetic acid can escape, the action continues to completion and pure sodium stearate remains. A similar reaction takes place with palmitic, myristic, lauric, and even caproic acid. From the fatty acid and salt a clear solution can be obtained which appears to be a colloidal solution of the soap. This is best observed with oleic acid, which acts in the same way as the saturated acids. Sodium acetate is soluble in oleic acid at 30°C., and is crystallised out from solution at about 22°C. At 40°C. about 10 per cent. can be dissolved. As soon as the sodium acetate is dissolved the oleic acid becomes more viscous. At 100°C. molecular proportions of oleic acid and sodium acetate give a clear solution. On cooling, this becomes a very thick jelly. Contrary to expectation, we find that when either stearic or oleic acid is mixed with an equivalent proportion of sodium acetate, heat is given out.

If the fatty acid, e.g., stearic acid, is dissolved in absolute alcohol and the acetate added, a gelatinous precipitate of soap is formed almost immediately. If water is now added, the reaction is reversed and we obtain the original fatty acid and sodium acetate.

COLLOIDAL SOAPS IN OILS.—If one per cent. of sodium acetate, propionate, butyrate, caproate, myristate, laurate, palmitate, stearate or oleate be added to an ordinary fat or oil (containing as usual free fatty acids) and warmed, a jelly or gelatinous precipitate (which in time settles towards the bottom of the vessel, forming a denser and more visible mass) will be formed in the case of the salts of the lower fatty acids. This is due to the reaction we have described above. With the salts of

the higher fatty acids a certain amount of the salt or soap goes into solution, but precipitates on cooling as a gelatinous mass. This is only clearly shown when a large percentage of fatty acids or olein, in which the soaps are soluble, is present. Sodium formate differs from the other salts, in that it is a salt of a much stronger acid, and its solubility in fatty acids is very low; consequently it does not give a jelly with olive oil, and only very slowly reacts with the higher fatty acids to form soaps.

All the jellies are formed most readily in the complete absence of water. They can be obtained as solutions in olive oil (which is rich in olein) by warming and filtering at 100°C. The soaps, under these conditions, are reversible colloids. On cooling, the jelly is usually slowly deposited as a mass of minute globules.

GENERAL NOTES.

MINERAL RESOURCES OF THE REPUBLIC OF COLOMBIA.

Although the public finances of Colombia are embarrassed, and the chief dependence at present for improvement is the prospective payment of 25 million dollars by the United States on account of the secession of Panama—which includes the Canal Zone—there is great potential wealth in the country. Gold, silver, and platinum are produced, and in the Eastern Cordilleras are large known deposits of iron, coal, copper, lead, quicksilver, and other metals and minerals. The emerald mines, controlled by the Government, are claimed to be among the richest deposits known anywhere. Petroleum has been prospected for at considerable cost, and though deposits have been found, production, so far, has been small. The local market is chiefly supplied by means of imports of crude oil.—*Board of Trade Journal.*

INCOME TAXPAYERS' SOCIETY.

An Income Taxpayers' Society has been formed with Lord Inchcape, G.C.M.G., K.C.S.I., K.C.I.E., as President, Sir William P. Treloar, Bart., Treasurer, and the Lord Decies, D.C., with the following objects:—

This Society has been founded to protect

and advance the interests of all payers of Income Tax, and amongst its objects are the following:—

1. To press for a reduction of the Income Tax as soon as the financial conditions of the country permit.

2. To press for redress of inequalities which specially affect the small Income Taxpayer.

3. To maintain the constitutional principle of control of the administration, assessment and collection of Income Tax by the taxpayers through the medium of their representatives, the Commissioners for the General Purposes of the Income Tax and their local officers.

4. To simplify the machinery of assessment by protecting the Income Taxpayer against the duplication and complexity of forms.

5. To watch suggested legislation and call attention to any proposed encroachments on the taxpayers' liberties.

6. To advise members on points of practice and to assist them generally.

7. To investigate cases of hardship and seek redress by all lawful means.

8. To seek to improve the incidence of Income Tax by advocating the abolition of anomalies.

9. To assist in approved test cases where a principle is involved affecting groups of Income Taxpayers.

The annual subscription for membership is as follows:—

For individuals, 5s. (minimum); for Corporations and firms, £1 1s. (minimum).

All enquiries and communications should be addressed to the Secretary, Income Taxpayers' Society, Iddesleigh House, Caxton Street, London, S.W.1.

SUGAR CANE WAX.

Amongst the constituents of the sugar cane there is a considerable percentage of wax which, when purified, resembles Caruba wax, and is consequently valuable. This wax collects in the press filter scum often to the extent of 10 %. An average of 100,000 tons of cane would give 250 of wax in the scum from clarification. The only existing method to extract the wax is to dry the press cakes and treat them with benzine. Wax thus obtained is hard and brown like beeswax. A practical process to extract this wax would be of great interest, as markets could easily be found.—*Bull. Inst. Col. Marseille*, No. 4, 1921).

CARBON DIOXIDE AS A FERTILISER.

Objections made by Dr. Claassen against the use of this gas as a fertiliser are criticised as follows by Dr. Riegel in the *Chemiker Zeitung*.

I quite agree with Dr. Claassen, of course, in respect to utilisation of this gas, which could only be undertaken when waste gas containing sufficient carbonic acid is available and the fields are not too far away.

There are, however, a considerable number of cases where circumstances are favourable, either on a small or a large scale. I made my estimates with the greatest prudence, calculating not only the extra cost for fertilisation, but also labour due to greater crops, and I took a very low price for the potato, which, to-day, is tripled.

Taking the price as double for the potato, viz., 60 marks per 50 kilos (110 lbs.), we have, after deducting 20 %, a yield of over 100 %. However, I purposely omitted this exceptional yield, fearing I might be called over optimistic.

Claassen considers, in any case, that the gassing of very large areas (several hectares) is relatively more expensive than small, but there is no foundation for such an opinion. The cost of pipes increases nearly in proportion with the diameter, but the capacity of utilisation of the pipes increases with the square of the diameter. Consequently the cost of the main pipe is less for large areas of soil and that of the branch pipes is also somewhat slighter.

For all these reasons the opinion expressed by Claassen that fertilising with gas, although the method has a theoretic or scientific value, is not practically possible, is absolutely erroneous, deceptive, and in contradiction with the teaching of experience. Moreover, this opinion is nullified by a subsequent statement that it would be possible to augment the economic yield by perfecting the method and plant. Evidently endeavours should be made to do so, the more so because carbonic acid fertilisation involves the maximum utilisation of waste heat which, in many cases, is only possible in this way. Many other ideas did not originate under more favourable auspices, e.g., the electric light industry, which has been improved technically and economically to such an extent that at the present day its use is universal. Had criticism been listened to at the outset, or facts neglected, electricity would never have developed to such a marvellous degree.

Considering that it has been practically and scientifically demonstrated that there is a gas which can increase the growth of plants twofold, is it right, at a time when vegetable products are so greatly needed, to remain idle, awaiting better times? Is it not a duty to gradually adopt such a system on an ever-growing scale?

In the meantime let me remark that at a meeting of the German Sugar Makers, Dr. Claasen spoke in favour of gas fertilisation. The difference in opinions seems simply to be in this, that Claasen maintains that we have no practical data respecting extensive applications, whereas Dr. Riegel advocates the use of gas in all places where circumstances favour subsequent development of the system.—*L'Engrais*, Dec. 16, 1921.

BELGIAN VARNISH SOLD AS BRITISH.

A reliable authority has reported to the Department of Overseas Trade the practice, on the part of certain sellers of varnish, of selling Belgian-made varnish as the product of fictitious firms, the reason, frankly admitted, being that there was a superior scope for the British product in this market. The experts, particularly the carriage builders, have, however, apparently penetrated the deception, and have been refusing all but the genuine British article, but the deception has been more successful in the provincial districts. Steps have been taken to put a stop to the practice, and exporters who have reason to suspect that their trade is being affected by any such procedure should immediately report the fact to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

PHARMACEUTIC PRODUCTS IN RUSSIA.

On June 1st, 1921, the Central Administration of Pharmaceutic Products had under their control 37 works, 10 in Moscow; 14, Petrograd, Central Russia and the Volga; 7, the Ukraine; 3, S.E. Russia; 1, Ural; 1, Crimea; 1, Turkestan. The works in the last-mentioned place produces about 500 poods (17,640 lbs.) of santolin yearly.

The Saky Works, Crimea, manufactured 2,500 poods of bromin per year, and that of Archangelsk about 400 poods of iodine.

Endeavours were made to run other iodine

works, especially at Tomsk, Ekaterinoslav, and on the banks of the White Sea and the Caucasus, but without success. There are hopes of being able to organise the manufacture of iodine in the Mourman district, on the peninsula of Ribatchy, where there is an abundance of sea-weed.

The Novotcherkassk Works extracts an average of 36 kilos of atropin yearly. The total pharmaceutic production is represented by 61,631 kilos from the Ukraine and Caucasus and 609,323 from the Moscow works. The remaining 90,281 kilos are supplied by other places. Moscow produces 80 per cent. of the total, chiefly in form of alkaloids and Salvarsan. Manufacture of alkaloids, bromine salts, quinine, caffeine, camphor, is quite new in Russia, and has not developed as expected. In addition to scarcity of coal, and other difficulties due to the critical situation, it is often impossible to find the medicinal plants required. Then there are not sufficient bottles, receptacles and packing cases.

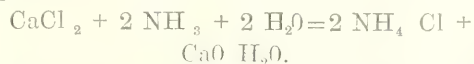
Nevertheless, if we may believe the Soviet statistics, the Russian pharmaceutic production has made progress, though slow, during the past few years.

"*Chimie et Industrie*," Nov., 1921.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences
Vol. clxxiii., No. 25, December 19, 1921.

The Precipitation of Lime with Precipitates of Ferric Oxide.—M. A. Charrion.—M. Toporescu (*C. R.*, clxx., p. 125) has studied the variation in the weight of lime carried down by ferric oxide as a function of the concentration of the solutions in ferric chloride and calcium chloride. The weight of lime carried down seems to be a function of the concentration of lime existing in the saline solution at the moment of the precipitation of the ferric oxide with ammonia. The excess of ammonia giving in presence of calcium chloride the following equilibrium:—



According to the law of mass action the concentration of the calcium hydrate ought

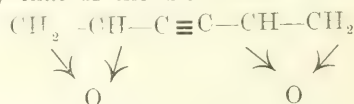
to vary in the same sense as those of the calcium chloride and ammonia and in the opposite sense to that of the ammonium chloride. The author has carried out a series of experiments in order to verify these conclusions, and has found that his results agree with those of M. Toporescu, as regards the inference of calcium chloride, for low concentrations. The weight of lime carried down first increases with increasing proportions of ammonia, passes through a maximum and then decreases. The existence of this maximum seems to be due to the formation of an addition product of ammonia and calcium chloride, favoured by the high concentration of ammonia in the solution. The weight of lime carried down diminishes slowly as the concentration of ammonium chloride increases. Thus in order that as little lime as possible may be carried down the concentration of the calcium chloride must be kept down, and the minimum quantity of ammonia must be used to precipitate the ferric oxide.

Halogen Derivatives of Indigos.—M. Grammontain. The author has shown that, as was to be expected on theoretical grounds, in the series of chloro derivatives of indigo octo chlor indigo is more violet than the 5.7.5'.7'. derivative and than pent a o hexachloro-indigo. The redness of the colouration is caused by the appearance of a new absorption band in the green region of the spectrum. This absorption destroys the green tinge which would otherwise be caused by the displacement of the principal ray in the red region of the spectrum. 5.7.5'.7'. tetrachlor-indigo is more violet than the corresponding bromine compound, chlorine having a less bathochromic influence than bromine, which produces less colouration than iodine. The study of the halogen derivatives of indigo shows that there are still certain difficulties to be overcome before the shade of new compounds and their tinctorial properties can be accurately foretold.

Catalytic Hydrogenation of Polyphenols in the Wet Way.—J. B. Senderens and J. Abouien. If attempts are made to hydrogenate resorcin in the wet way it is found that at 200° and a high pressure decomposition products are chiefly obtained, while at a low temperature and pressure no hydrogenation occurs, even when the constituents are well shaken. The authors have succeeded in reducing the polyphenols

under a fairly high pressure and at as low a temperature as possible, meanwhile shaking thoroughly, and in four hours can convert 1 kg. of resorcin in solution in alcohol or water into 1.3. cyclohexanediol. Similarly they have easily effected the total reduction of pyrocatechin, pyrogallol, phloroglucine and oxyhydroquinone.

Derivatives of Acetylenic erythrite
 $\text{CH}_2\text{OH} \cdot \text{CHOH} \equiv \text{C} \cdot \text{CHOH} \cdot \text{CH}_2 \cdot \text{OH}$.—
 M. Lespieau.—When the dichlor ether $\text{CH}_2 \cdot \text{Cl} \cdot \text{CHCl} \cdot \text{O} \cdot \text{C}_2\text{H}_5$ reacts within the di
 magnesium derivative of acetylene a liquid
 of formula $\text{CH}_2 \cdot \text{Cl} \cdot \text{C} \equiv \text{C} \cdot \text{CH} \cdot \text{OC}_2\text{H}_5$ is obtained, and this liquid is a
 mixture of an inactive and a racemic substance, for on the addition of two atoms of
 bromine two different isomers are formed
 which do not appear to be cis and trans
 isomers. It might be thought that it
 would be easy to pass from these ether
 oxides to the corresponding glycols, but this
 has not been found to be the case. When
 monochlor aldehyde acts on the magnesium
 derivative of acetylene an energetic reaction
 occurs. If the product is treated with
 acidified water and extracted with ether
 which is afterwards evaporated off a black
 viscous mass is obtained which gives only
 decomposition products when heated in a
 vacuo. On the addition of bromine, after
 the lapse of several months it was observed
 that crystals had formed, and in the course
 of some years enough of these had accumulated
 to be investigated. They are monoclinic
 crystals, melting at 141°—142.5°, and
 their composition corresponds to the formula
 $\text{CH}_2 \cdot \text{Cl} \cdot \text{CHOH} \cdot \text{CBr} \cdot \text{CHOH} \cdot \text{CH}_2 \cdot \text{Cl}$.
 When potassium is added to the
 viscous mass, mentioned above, after treating
 it with ether heat is generated and a
 brackish precipitate is formed, the ether
 becoming clear. If the ether is decanted
 off and distilled under reduced pressure a
 colourless oil is obtained, and analysis
 shows that its composition is very approximately
 that of the dioxide



Although the boiling point is constant it is possible that this oil is a mixture of stereoisomers, and the author is pursuing its investigation.

PROCEEDINGS OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, DEC. 8, 1921.

PROF. C. S. SHERRINGTON, President,
in the Chair.

The following Papers were read, the summaries here printed having been supplied by the Authors for use at the meeting:—

LORD RAYLEIGH, F.R.S. A Study of the Glow of Phosphorus.—Periodic Luminosity and Action of Inhibiting Substances.

The paper deals with the intermittent or periodic luminosity observed to be propagated through the gas space when the last traces of oxygen are being removed from air by means of phosphorus, or when air is allowed slowly to leak into an exhausted vessel containing phosphorus.

(1) It is shown that this effect, as ordinarily observed, requires the presence of water vapour. Moderate drying (*e.g.*, by sulphuric acid) makes the glow perfectly steady. Water vapour has therefore the power of inhibiting the combination of phosphorous vapour and oxygen within certain limits. When the composition of the mixture becomes favourable beyond those limits a wave of combustion is propagated.

(2) Other substances are known to inhibit the glow of phosphorus. Some of these can be used to exhibit the above phenomena in a far more striking form than water. Camphor, ammonia and pear oil are among the most effective, and experiments with them are described in detail.

(3) It is shown that the propagation of these waves of combustion cannot be attributed to the rise of temperature of one layer igniting the next layer, for the rise of temperature is too small. An alternative theory of the propagation is proposed, which assumes that it depends on the provision of nuclei, as in the propagation of crystallisation through a supercooled liquid.

(4) On this basis a theory of the action of the inhibitors (sometimes called "negative catalysts") is developed.

LORD RAYLEIGH, F.R.S. The Aurora Line in the Spectrum of the Night Sky.

(1) The spectrum of the night sky at Terling (not far from London) has been photographed systematically. The aurora line at wave-length 5578 is recorded on about two nights out of three.

(2) Its intensity on ordinary nights does not seem to be obviously related either to the amount of magnetic disturbance, or to

the transit of spots over the sun's central meridian.

(3) The intensity in the neighbourhood of Newcastle is notably less than near London, thus the effect appears to increase towards the south. It would seem, therefore, to be due to some different cause from the Polar aurora.

(4) It is confirmed that the aurora line does not coincide with krypton. Some experiments to determine its origin are described, but the results are negative.

E. F. ARMSTRONG, D.Sc., F.R.S., and T. P. HILDITCH, D.Sc. A Study of Catalytic Actions at Solid Surfaces. VII.—The Influence of Pressure on the Rate of Hydrogenation of Liquids in presence of Nickel.

The comparative rates of absorption of hydrogen at different pressures by a variety of unsaturated compounds in presence of nickel have been studied, and it is found that the relation between the hydrogen pressure and the rate of hydrogenation is dependent on the type of organic compound which is examined.

Simple ethylenic compounds are hydrogenated, in presence of sufficient nickel, at rates which are in almost exact proportion to the absolute pressure of the hydrogen.

At very low concentrations of catalyst (*e.g.*, 0.01—0.02 per cent. of nickel reckoned on the organic compound) the increase in rate of hydrogenation becomes less than proportional to the increase in pressure, an effect which is especially marked in the cases of multi-ethylenic compounds such as linolein or citral.

If the unsaturated compound contains another group which has affinity towards nickel (but is not open to hydrogenation), increase in hydrogen pressure causes an increase in the rate of hydrogen absorption in more than simple proportion to the altered concentration of hydrogen.

Unsaturated compound.	Effect of pressure.
Ethylenic hydrocarbons or esters	Normal
Ethylenic alcohols	Abnormal
Ethylenic aldehydes or ketones	Normal
... ..	or subnormal
Ethylenic acids	Abnormal

These results are shown to be in harmony with the authors' theory that catalytic hydrogenation is primarily conditioned by an association of the ethylenic linkage with the catalyst, the latter being also associated with hydrogen.

W. D. WOMERSLEY. The Energy in Air, Steam and Carbon Dioxide from 100°C. to

2,000°C. Communicated by Sir Dugald Clerk, F.R.S.

The paper gives the results of experiments carried out early in 1919 with the Hopkinson Recording Calorimeter for Explosions. The combustible gases exploded in the experiments were hydrogen and carbon monoxide mixed with either air or oxygen. Curves showing the energy in the various gases and also the mean volumetric heats from 100°C. to 2,000°C. are given. The values are found to be, where comparable, about 7½ per cent. higher than those of Holborn and Henning.

The difficulty in estimating the heat liberated in a closed-vessel explosion experienced by Hopkinson was found to be due probably to a spontaneous time reaction between the combustible gas and oxygen when the two are mixed, and about 10 per cent. of the gas was found to be consumed, on this account, previous to the actual explosion.

The combustion of carbon monoxide was found to be considerably slower than that of hydrogen, and even one second after ignition there was still present in the calorimeter a considerable amount of unburnt carbon monoxide. This fact made the estimation of the heat liberated in the carbon monoxide experiments very uncertain. There seems to be no reason why this phenomenon should not have occurred in the experiments of other workers, but it is not mentioned by them as in any way affecting their results.

An appendix is given showing the results of experiments carried out with the calorimeter on the rates of heat-flow to the walls, with the latter both polished and blackened.

LIEUT.-COL. J. W. GIFFORD, F.R.A.S. Atmospheric Pressure and Refractive Indices, with a Corresponding Table of Indices of Optical Glass. Communicated by Sir Joseph Petavel, F.R.S.

Under a special method, previously described, more accurate results were obtained and a correction for temperature introduced. Later it was felt that the greater accuracy had been only partially achieved. There remained to be dealt with a correction for pressure. It had been pointed out that the modulus of rigidity for glass precluded its being sensibly affected by pressure, and that therefore any such effect must be due to air alone.

Similar formulae for the variation of the refractive index of air with temperature at given pressure have been given by Benoit

and by Mascart. The index for air at standard pressure and 0°C. given by Benoit is the mean of that given by a number of other observers. Adopting this and the mean of the constants given by Benoit and Mascart, we have—

$$n_0 = 1.0002923 \text{ at standard pressure (760 mm.) } n_t - 1 = \frac{n - 1}{1 + 0.00374t}$$

The application of this formula for correction is as follows:—

Let

P = standard pressure

p = observed " in mm. of mercury.

n = refractive index of air at standard pressure and observed temperature.

$$1 + \frac{(n-1)p}{P} = n' = \text{refractive index of air at}$$

observed pressure and observed temperature.

μ = refractive index of substance at observed pressure and observed temperature.

μ' = refractive index of substance at standard pressure and observed temperature.

From this and two measurements of refractive index of same wave length, at different temperatures, the refraction temperature coefficient at standard pressure for 1°C. is determined. Using this coefficient as a final correction, indices for other wavelengths at standard pressure and observed temperature may be brought to standard pressure and temperature (15°C.).

Worked examples: a table of corrected refractive indices, and a list of corresponding temperature refraction coefficients follow.

H. P. WARAN. A New Form of Interferometer. Communicated by Prof. H. F. Newall, F.R.S.

The paper describes briefly the results of some successful experiments conducted under great experimental difficulties at Madras to test the practicability of employing a thin layer of transparent liquid floating over mercury as a parallel plate interferometer—a substitute for Lummer and Ghercke's glass plate. The employment of viscous castor oil proved the success of the idea, but its poor transparency stood in the way of securing high revolving power. The disturbing influence of the tremors of the ground was overcome by mounting the trough on a float suspended from the ceiling in a tank of water carried on a massive brick pillar with deep laid foundations in the

cellar of the laboratory. The advantages of such a form of interferometer are briefly stated. The fringes obtained are found to be quite sharply defined and suitable for refined measurements.

H. HARLE, A.R.C.S., B.Sc., D.I.C. On the Viscosities of the Hydrogen Halides. Communicated by Prof. H. L. Callendar, F.R.S.

The paper describes an experimental determination of the coefficients of viscosity of the gaseous hydrogen halides, undertaken with a view to affording a check upon the theoretical investigation by A. O. Rankine (Proc. Phys. Soc., 1921) on the diameters of unsymmetrical molecules.

The method of continuous transpiration through a capillary tube is used, the constant in the expression for being determined, using the known data for air. The gases are liquefied, and, by a means of controlling the evaporation, establish their own steady pressure while transpiring through the tube, the pressure difference being read on a U-tube gauge with a suitable liquid. The volumes of gas passing in a given time are arrived at by absorbing in water and titrating with standard alkali solutions, using the known density of the gas in the case of HCl, while for HBr and HI separate experiments were made to determine the density under conditions identical with those of the viscosity experiments.

Values of were obtained at two temperatures, round about 15 and 100°C., and from them Sutherland's constant of temperature variation is calculated for each of the gases.

INSTITUTE OF CHEMISTRY OF OF GREAT BRITAIN AND IRELAND. PASS LIST.

EXAMINATIONS: JANUARY, 1922.

The following candidates have been successful in the recent Examinations and have been duly elected Associates of the Institute:

Examination in General Chemistry.

Crossingham, John Harold.
Hyland, John Lawrence.
Randall, Frederick Charles, B.Sc. (Lond.).
Stevenson, Samuel Gordon.

Examination in Organic Chemistry.

Brazier, William Ernest.
Cuckney, Malcolm.
Dorrick, William.

Examination in the Chemistry of Foods and Drugs, etc.

Wright, Neville Lushanus, D.I.C.
The following candidates have been suc-

cessful in the Examination and have been duly elected Fellows of the Institute:

Examination in Inorganic Chemistry (Section II.), Metallurgy.

Scholes, Alfred.

Examination in Agricultural Chemistry..

Arnold, Charles William Brown, B.Sc. (Lond.).

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

LECTURES BEFORE EASTER, 1922.

FRIDAY EVENING DISCOURSES

addressed to members and their friends at 9 p.m.

February 3.—Lieut.-Colonel Sir Francis Younghusband, K.C.S.I., K.C.I.E.—“The Mount Everest Expedition.”

February 10.—W. D. Halliburton, M.D., LL.D., F.R.S., Prof. of Physiology, King's College, London.—“The Teeth of the Nation.”

February 17.—Dr. S. M. Watson, MSc., Jodrell Prof. of Zoology and Comparative Anatomy, University of London.—“History of the Mammalian Ear.”

February 24.—John Joly, DSc., F.R.S., Prof. of Geology, University of Dublin.—“The Age of the Earth.”

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—“Problems in the Variability of Spectra.”

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—“The Pigments and Mediums of the Old Masters.”

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—“Auxiliary International Languages.”

March 31.—Arthur B. Walkley, B.A., Author of “Drama and Life,” etc.—“Jane Austen.”

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—“Evolution of the Elements.”

January 28.—Dr. C. Macpherson—“The Evolution of Organ Music.”

January 31.—Prof. H. H. Turner—“Variable Stars.”

February 2. — Sir Napier Shaw—“Droughts and Floods.”

ROYAL INSTITUTION. — Next Tuesday (Jan. 31) at three o'clock Professor H. H. Turner begins a course of three lectures at the Royal Institute on *Variable Stars*; on Thursday (Feb. 2) Sir Napier Shaw delivers the first of two lectures on "Droughts and Floods," and on Saturday (Feb. 4) Dr. E. de Selincourt commences a course of two lectures on "Huntarists of the Seventeenth Century": 1, Sir Thomas Browne; 2, Thomas Fuller. The Friday Evening Discourse on February 3 will be delivered by Sir Francis Younghusband on the "Mount Everest Expedition," and on February 10 by Dr. Halliburton on the "Teeth of the Nation."



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks and Designs can be obtained gratuitously.

Latest Patent Applications.

- 357—Binnatoux, R. L.—Process to improve Bessemer, acid, or basic steel. Jan. 5.
- 393—Chemische Werke vorm. Anorgos.—Processes for producing pure titanic acids from titanic ores. Jan. 5.
- 441—Douglas, R. P.—Manufacture of sulphate of ammonia. Jan. 6.
- 567—Elektrizitätswerk Lonza.—Process for improving electrolytic mercuric oxide. Jan. 7.
- 474—Imray, O. Y.—Manufacture of dye-stuffs from anthraquinone. Jan. 6.
- 277—Kirby, E. B.—Metallurgical furnaces. Jan. 4.
- 172,993—Wallis, R. L.—Production of organic compounds adapted for use as antiseptics and processes of sterilization, disinfection, and the like.
- 173,004—Adam, M. A.—Production of butyric aldehyde and butyric acid therefrom.
- 158,531—Surpass Chemical Inc.—Process of dyeing.
- 173,060—Reed, C. J.—Processes for making sulphuric acid.
- 173,063—Imray, Y. O.—Manufacture of soluble derivatives of camphoric acid.
- 153,006—Ges. Landwirtschaftlichen Bedarf. and Mandelbaum, R.—Treatment of gas liquor in order to extract a fertilizer therefrom.

Abstracts Published this Week.

Zinc Lead.—Patent No. 171,722.—A method of treating Zinc Lead ores has been patented in this country by Mr. C. E. Cornelius, of 22, Narvagen, Stockholm. The vapours from a zinc reduction furnace are highly cooled, for example, to approximately 60 to 70°C., by means of cooled channels, tubes, etc., whereby the whole of the zinc is condensed to powder form and the reduction gases escape through an outlet. The zinc powder, protected from contact with air, is conveyed to a furnace from conversion to the liquid state. Zinc and lead are obtainable in this way from ores containing both metals.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on post free for the official price of 1s. each.

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the **EDITOR**.

SUBSCRIPTIONS £1 12s. per annum, payable in advance, should be addressed to the **MANAGER**.

BACK NUMBERS and **VOLUMES** can be purchased on application to the **MANAGER**.

THE CHEMICAL NEWS,
97, SHOE LANE, LONDON, E.C.4.

ADVERTISEMENTS.

All communications should be addressed to—

ADVERTISEMENT DEPARTMENT,

63, LUDGATE HILL, LONDON, E.C.4.

CHEMICAL ASSISTANT. — Applications are invited for temporary employment as a Chemical Assistant in the London County Council Public Health Department at a rate of pay of three guineas a week plus temporary additions subject to periodical revision. As far as can be estimated at present the total weekly remuneration as at 1st March, 1922, will be about £5 13s. 0d. Candidates (who may be of either sex) must be natural-born British subjects unless they served with H.M. Armed Forces during the War, and not less than 25 or more than 40 years of age, and must furnish evidence of thorough training in chemistry and allied sciences.

Preference given to candidates who have served or attempted to serve with H.M. Forces, and particularly to disabled men.

Application (in writing), stating qualifications, experience, War service (if any), etc., should be addressed to the Clerk of the Council, County Hall, Spring Gardens, S.W.1, and should reach him not later than 11 a.m. on Monday, 6th February, 1922. Canvassing disqualifies.

GOVERNMENT LABORATORY. — Temporary Assistant Chemists required. Age 20-25. Qualifications, B.Sc. with not less than 2nd Cl. Hons. or equivalent. Salary, Men £160-£10-£220, Women £140-£10-£180, plus usual Civil Service bonus. At present £160 is equivalent to £319 18s., but this will be revised on 1st March.—Apply, with copies of testimonials, Government Chemist, Clement's Inn Passage, W.C.2.

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3225.

THE INFLUENZA EPIDEMIC.

PRESENT VISITATION PANDEMIC. PRECAUTIONS TO BE TAKEN.

1.—The Ministry of Health issues the following statement as to the present position, based on information obtained by its medical staff since December last.

2.—Outbreaks of influenza in England began in November, notably in the western areas of Nottinghamshire, whence it spread to towns in the south of the West Riding (where Leeds, Sheffield and Rotherham were principally affected) and westwards towards the Potteries. In the areas thus attacked early the epidemic has now materially abated or practically ceased. In London, although there was evidence of influenza in the schools about the end of November, the disease did not become generally prevalent until the middle of the following month. The northern, southern and eastern Registration Districts of London have been those mainly affected. During the last fortnight the epidemic has further extended, and the disease is now widely prevalent in many parts of England and Wales. In the 96 great towns, during the week ending 14th January, the deaths from influenza (including bronchitis and pneumonia complicating influenza) totalled 1,240. Of this number 551 occurred in London. During the same week the deaths in London attributed to pneumonia (without mention of influenza) rose from 318 to 457, and those attributed to bronchitis from 282 to 394.

Weekly returns from the towns where the wave has now apparently spent its force suggest a duration of the epidemic in individual areas of 6 to 7 weeks. This fact, and the slackening rate of increase in London, encourage the hope that the epidemic in the metropolitan area is at or near its maximum.

3.—The epidemic on present evidence may be classed with those which occur with some regularity in the years which follow a great pandemic. It bears the same relation in time to the pandemic of 1918-1919 as the recrudescence of 1895 bore to the severe

epidemic of 1892—the most fatal of the three waves which affected London in the pandemic period 1889-1892. As compared with the 1918-1919 period the number of persons now being attacked is smaller, and the severity of the disease is usually much less. In this connection the figures already given may be compared with those of the week of maximum incidence in 1918, when there were 7,557 deaths in the 96 great towns, 2,458 of which occurred in London.

4.—Epidemic influenza varies notoriously not only in its severity, but in the symptoms by which it is characterised. In ordinary cases during the present prevalence the attack takes the form of two or three days' fever. The acute catarrh of an ordinary heavy cold is by no means general. The most frequent symptoms are sudden onset, headache, pain in the back and legs and congestion of the throat, with some bronchial catarrh and an irritating and very persistent cough.

Most of the deaths attributed to influenza have been due to pulmonary complications, although these complications in the young adult and persons of early middle age are occurring far less frequently than in the pandemic years of 1918-19.

Stress may again be laid on the importance of persons attacked by influenza at once going home to bed, keeping warm, and obtaining necessary medical and nursing treatment. Special care should be taken to guard against the risk of broncho-pneumonia in young children, who, when attacked by influenza, should be kept at home in a warm room until the symptoms are over.

It must be realised that for most people leading an active life it is difficult, if not impossible, to avoid infection. As a preventive measure throat gargling and particularly nose washing (insufflation) every night and morning may be adopted, the most useful solutions being potassium permanganate 1 in 5,000 parts (4 or 5 crystals of permanganate of potash and a teaspoonful of salt to a pint of warm water) or liquor sodæ chlorinatæ (20 drops to a tumbler of warm water). It does not appear that available influenza vaccines prevent attacks of influenza, but their judicious and timely use gives material security against the more dangerous complications, particularly pneumonia, which may result from an attack.

BIRMINGHAM UNIVERSITY.

[Personal. The Council of the University of Birmingham report to the Court of Governors, who will hold the annual meeting on February 9, that in order permanently to associate the name of Professor Percy Frankland, F.R.S., D.Sc., with the Chemical Department of the University, and to commemorate his eminence as a worker in chemical science, a fund has been subscribed to provide a Frankland medal and prize of books, to be awarded annually to the best student of practical chemistry.]

The Council of the University of Birmingham, in their annual report to the Court of Governors, state that owing to the increase in the number of students the work at the Mason College Buildings of the University (in central Birmingham) is too congested, and there is great need for additional laboratories, lecture theatres, and classrooms. Where laboratories were concerned, their insufficient size frequently required duplication of classes, and even then the space available was quite inadequate. If it were possible to transfer the three biological departments (zoology, botany and the school of brewing and bio-chemistry) to the new University buildings at Edgbaston, considerable relief would be afforded, but this proposal raises large questions of finance, which have yet to be considered. Touching on the question of Research, the Principal (Mr. Grant Robertson) points out that the Joint Standing Committee of Council and Senate for organising and promoting the Research had been definitely set up, and had already done admirable work. On its advice, two important exploratory investigations, inaugurated by Government Departments, had been accepted, in addition to many other investigations already in hand. He was confident this committee had a great future in co-ordinating, inaugurating and encouraging research in all the faculties which in many cases would have a direct bearing on the industrial efficiency and prosperity of the Midlands. A matter for satisfaction was the transfer to the Birmingham University of the Coal-Owners' Association's Mining Research Laboratory. Not the least satisfactory feature of the transfer was the

Association with the University (as hon. professor and director) of so distinguished an expert as Dr. J. S. Haldane, F.R.S., together with his expert assistant director, Mr. Ivor Graham. Owing to the demands made upon it by various Departments (particularly those of Mining and Petroleum Engineering) the geological staff required strengthening. The Principal also points out that the biological sciences had reached a point at which their application to health, to agriculture, to industry, to imperial development and to education was increasing daily, but the value and contribution of "applied" Biological science would be largely determined by the advance in "pure" biological science. Was the University of Birmingham, he asked, to have its proper place and share in this development?

The Mutual Action of Adjacent Photographic Images, *Astrophysical Journal*, 53, 349-374, June, 1921. The University of Chicago Press, Chicago, Ill. By Frank E. Ross.

ABSTRACT.

Mutual action of adjacent photographic images. (1) *Stars and bright lines.* A review of previous work shows that the results are so conflicting that general conclusions cannot be drawn. Three factors seem to control the action. The *turbidity effect* causes an attraction through optical reinforcement of adjacent sides of the images. An equation is derived from which the attraction is found to be negligible, except for very small images very close together. The *gelatine effect* causes an attraction due to the more rapid drying of the developed image. It is measured by the difference in the separation of images when wet and when dry. For normal exposures of star images less than 0.1 mm apart the attraction is equal to about 2μ for ordinary developers excepting pyro-metol, while in the case of lines the attraction is about 5μ . This attraction is only slightly changed by varying the amount of sulphite or by the use of a hardener. The *developer or Kostinsky effect* causes a repulsion as a result of the restraining effect of the products of the developing reaction, as in

the Eberhard effect. It varies somewhat with the developer, but increases with the exposure. The variation of the total effect with exposure is such that overexposed images show strong repulsion due to the large developer effect, whereas normally exposed images show an attraction which usually amounts to 2 or 3 μ . To minimise the error which the effect may introduce into measurements of such images, the exposure should be as short as possible. The phenomenon is so complicated that it may be impossible to eliminate it completely. (2) In the case of absorption lines, both the gelatine effect and the developer effect cause a repulsion, but in addition to the attraction due to the turbidity effect there is a further attraction due to a difference in the sharpness of outer and inner edges caused by turbidity and halation. In general the total effect is an attraction, about 1 μ for normal exposures, but larger for overexposures. Seed 30 plates were used.

Effect of exposure on the time of drying of photographic film.—A normally exposed image dries faster than an underexposed or an overexposed region.—GORDON S. FULCHER.

The Spectrum of Fluorine, *Astrophysical Journal*, 54, 133-139, September, 1921. The University of Chicago Press, Chicago, Ill. By William R. Smythe.

ABSTRACT.

Preparation of fluorine gas by electrolysis of fused potassium acid fluoride.—The method due to Mather and others of the Chemical Warfare Service is described, together with the necessary apparatus. The gas was purified by passing through sodium fluoride and a freezing trap. To protect the pump a charcoal trap was inserted.

Visible and ultra-violet spectrum of fluorine and carbon tetrafluoride.—A dozen previous researches have failed to determine definitely the lines due to fluorine because of impurities in the gas used. In this research a spectrum with foreign lines absent or very weak was obtained by flowing practically pure fluorine gas at atmospheric pressure continuously through a discharge tube with gold electrodes. Although the tube had a fluorite window, put on in optical contact

without cement yet practically air-tight, and both a quartz spectrograph and a 50 cm concave grating were used, the only fluorine lines found were ten between λ 6239 and λ 7034. The wave-lengths of these lines, determined to about 0.1 Å, are given, and also the approximate positions of the heads of nine bands presumably due to CF_4 , between λ 4829 and λ 6525.—GORDON S. FULCHER.—Issued by the University of Chicago Press.

GEOLOGICAL SOCIETY OF LONDON. ABSTRACTS OF THE PROCEEDINGS.

December 21st, 1921.

Mr. R. D. Oldham, F.R.S., President,
in the chair.

The following communications were read:—

1. "The Nature and Origin of the Pliocene Deposits of the County of Cornwall and their bearing on the Pliocene Geography of the South-West of England." By Henry Brewer Milner, M.A., D.I.C., F.G.S.

The author discusses the petrography of those Tertiary deposits of Cornwall which, by reason of similar mode of occurrence and lithological resemblance to the well-known fossiliferous beds of St. Erth, have been provisionally assigned to the Pliocene Period. Such deposits occur at St. Agnes, St. Erth, Lelant Downs, Polcrebo, and St. Keverne; except those of St. Erth, all are unfossiliferous.

By petrographic methods of correlation, using St. Erth as a type-locality, the relative age of the St. Agnes and St. Keverne beds is established. At Lelant Downs no deposit occurs *in situ*, but scattered blocks of an indurated ferruginous grit are found at an elevation corresponding to that of the St. Erth beds on the opposite side of the valley, and a potential relationship is accordingly admitted. The Polcrebo gravels differ from the other deposits, and are referred to a later period.

The average composition of the St. Agnes, St. Erth, and St. Keverne deposits is shown to be substantially the same, the important "heavy" minerals common to all being magnetite, ilmenite, tourmaline, staurolite, epidote, zircon, anatase, rutile, topaz, andalusite, and cassiterite; garnet was found only at St. Erth, kyanite at St. Agnes and St. Erth. On this basis, correlation of the deposits is effected by considering (1) the frequency of occurrence of individual species; (2) their persistence or distribution; and (3) the constancy of crystallographical, physical, and optical properties of grains of the same mineral, wherever met with.

The source of the material is essentially local, although kyanite and staurolite are "foreign" species; the former, from its striking Lower Greensand habit and absence from St. Keverne, is thought to be derived from the north-east, the latter from a land-mass lying on the south, probably united to Cornwall and Devon in late Miocene times, before early Pliocene submergence set in. The gradual "swamping" of sediment-bearing rivers by the advancing Pliocene sea from the south-west is correlated with certain physical features apparent, especially the "400-foot plateau."

DISCUSSION.

Prof. P. G. H. BOSWELL welcomed the paper as a contribution to our knowledge of the petrology of the Tertiary deposits of the West of England. The author's records of the characteristic minerals were confirmed by the speaker's own identifications. It was a noteworthy but unexplained fact that, while the Permian, Trias, Lias, and Inferior Oolite strata of the West of England were characterised by an abundance of garnet, that mineral was absent from or extremely rare in the Cretaceous, Eocene, Oligocene, and Pliocene of Devon and Cornwall, although it was a common constituent of the Palæozoic rocks of Devon, Cornwall, and Brittany.

He enquired why the author desired to have the staurolite in the St. Keverne sands derived from the old "Armorican" land on the south-west, unaccompanied by its usual associate, kyanite; while, in the case of the sands at St. Agnes and St. Erth, he assumed a Lower Greensand origin in the north-east for the same two minerals. The

absence of kyanite at St. Keverne seemed to be inconclusive in the matter of the derivation of the material.

The paper was valuable for the additional light which it threw upon early Pliocene geography. The author's conclusions, although novel, were not necessarily inconsistent with our ideas of the distribution of Pliocene land obtained from a study of the fauna of the St. Erth clays and the Craggs. That the migration of southern species into the North-Sea basin over what is now the English Channel and Kent was possible in early Pliocene times, but was prevented during the deposition of the Middle and Upper Pliocene, presumably by the raising of a land or shallow-water barrier, is indicated by the molluscan faunas; further, the totally different character of the mineral assemblages of the Cornish and East Anglian Pliocene (the latter having apparently been derived from the south-east) supports the view. Moreover, the similarity in certain mineralogical respects (notably in the rarity of garnets) of the Lenham Beds and the Cornish Pliocene may prove to be more than mere coincidence.

Mr. G. M. PART said that he had hoped that this paper might suggest some reasonable source for the very similar assemblage of minerals found in some of the Glacial drifts of Pembrokeshire, which it could only be surmised were derived from some similar Tertiary deposit. As the Pembrokeshire drifts were derived from a westerly or north-westerly direction, this would involve a northern drainage if Cornwall had provided any of the material for a deposit from which the blood-red pleochroic andalusite had found its way into the gravels.

Dr. H. H. THOMAS agreed with the author that the kyanite of these deposits was most probably derived from sediments of Cretaceous age. The absence of kyanite from the western New Red rocks was strong evidence in support of the author's view. He thought that the grains of staurolite with frayed-out cleavages owed this distinctive character to their derivation from large crystals. This was the conclusion to which he had come from a study of the abundant and large grains found in the Western Trias. With regard to the great similarity between the mineral assemblages of the Cornish Pliocene and the drift-sands of Pembrokeshire, he had many years ago sug-

gested the latter's partial derivation from Tertiary deposits occupying, in Glacial times, a position in the bed of the Irish Sea.

Mr. G. BARROW was greatly interested in the author's work, as it dealt with what are commonly known as Pliocene deposits, now occurring at heights much above sea-level. The Geologists' Association had taken a special interest in these high-level deposits, which occurred in patches extending from the south-east of Kent at least as far as the neighbourhood of the Guildford gap in the Chalk. Apart from the Lenham Beds, fragments of undoubtedly marine shells have been found in the gravels of Headley Heath. The mode of occurrence of these is important, as it suggests where to look for further casts. They occur only when the sand surrounding the original shell-fragments has been firmly cemented by iron-oxide, and nowhere else. The examination of the deposit on the ground suggests that these gravels are beach-deposits, with broken shell-fragments once common in them. All these fragments have been dissolved; but, where iron-oxide filtered in and cemented the sand before solution took place, casts of some fragments are preserved. It is in such cemented patches that we must in future look for evidence of the age and nature of these beds; this knowledge not only shows where to look, but where it is useless to look, and this so far covers more than 90 per cent. of the whole.

Mr. T. CROOK said that it was particularly pleasing to note the emphasis laid on sampling. Failure to record a mineral in such deposits did not necessarily mean that the mineral was absent; but, with careful sampling, such as the author appeared to have carried out, much better results were likely to be obtained than when records were made on specimens collected haphazard. It seemed to the speaker that it would be very useful if the author would include in his paper an account of the method of sampling adopted, so that other workers might be able to obtain results that were fairly comparative.

With regard to the mineral composition of the sediments described, it was perhaps worth while to enquire whether the relative amounts of such minerals as garnet, staurolite, and kyanite, which were all metamorphic minerals in the ordinary sense, and might have emanated from the same ultimate source, were in any way connected themselves where the proximate derivation

was from other sediments, and where consequently the minerals had suffered repeatedly from the action of processes incidental to detrital sedimentation, possibly under a wide range of climatic variation.

Dr. J. W. EVANS thought it improbable that the relative level of land and sea changed to the same extent throughout the area concerned. He did not believe that material could have been transported from the north-east by coastal wave-action. On the northern coast of Devon and Cornwall it was the north-westerly winds that produced the most important transporting action, and the movement was from south-west to north-east not *vice versa*. If the kyanite had travelled from the Lower Greensand of the neighbourhood of Devizes, it must have been by means of river-action, when the Bristol Channel was a tract of alluvium and Devon and Cornwall were at a relatively low level.

Mr. R. B. NEWTON declined on palæontological grounds to accept a Pliocene age for the St. Erth deposits. His own studies (see Journ. Conch. vol. xv, 1916) of the shells from those beds were all in favour of their Upper Miocene horizon, and as exactly the same facies was apparent among the Lenham mollusca, he was of opinion that the St. Erth and Lenham Beds were of contemporaneous origin. He mentioned the occurrence of similar species of shells in the Gourbesville deposits of Normandy which had been described by M. Gustave Wolfus (Bull. Soc. Géol. Normandie, 1880, and C. R. Assoc. Franç. Av. Sci., Cherbourg, 1906, pp. 358-70), and referred to the Redonian stage of the Miocene, which is considered the equivalent of the Upper Vinobonian horizon of Europe. The speaker was also of opinion that the palæontological evidence proved that the St. Erth, as well as the Lenham deposits, represented fragmentary remnants of the Continental Miocene development which extended from Holland, Denmark, Northern Germany, and Northern France.

The AUTHOR, in reply to Prof. Boswell, said that it appeared to him unlikely that the staurolite could have come from the north-east, in view of the absence of kyanite from St. Keverne; if both the minerals had been derived from the north-east, kyanite should have penetrated at least as far as the staurolite, and it should appear with the latter at St. Keverne, which is actually not the case. In reply to Mr.

Part, the Author said that he had noticed the resemblance of the andalusite from the Glacial gravels of Pembrokeshire to the Pliocene species, but there was little doubt in his mind that the source of the Pembrokeshire deposits was from the west, possibly from an area now covered by the Irish Sea. In answer to Mr. Crook, the Author discussed the methods of sampling in the field at equal intervals along the strike of the deposits, and at each change of the lithological facies in vertical sections. The Author agreed with Dr. Evans that probably Cornwall stood at a higher level in early Tertiary times than it does at present; he specially drew attention, however, to the distinction necessary between the Tertiary deposits now occurring on either side of Dartmoor. In reply to Mr. Newton's criticism of the use of the word "Pliocene" in connexion with these deposits, the Author said that this was essentially a palæontological aspect of the subject, and one which he did not feel competent to discuss; he had always been content to accept as a basis the admirable work of the late Mr. Clement Reid on the Pliocene deposits of Britain.

2. "The Phosphate Deposit of Ocean Island." By Launcelot Owen, A.R.S.M., A.R.C.S., F.G.S.

Ocean Island (lat. $0^{\circ} 52' S$; long. $169^{\circ} 32' E$), in the Western Pacific Ocean, consists of a mass of terraced and dolomitized coral-limestone which rises to a height of 300 feet above low water, spring tide.

Its surface is almost completely covered by a capping of calcium phosphate of exceptional purity. This phosphate can be divided into three varieties.—(a) amorphous calcium phosphate, formed of the insoluble residue of the original guano; (b) detrital coral-limestone, converted into calcium phosphate by solutions leached from the guano; and (c) phosphatized coral *in situ*.

The dolomitized limestone base shows evidence of having suffered considerable subaërial and marine erosion prior to the deposition of the guano, this deposition having occurred during the final emergence of the island.

A detailed study of the composition of the deposit shows that the percentage of tricalcium phosphate ($Ca_3P_2O_8$) at any point varies in a remarkably regular manner, according to the position of the point of the island. So regular is this variation, in fact, that, if the position and height above sea-

level of any point are known, the percentage of tricalcium phosphate in the deposit at that point can be foretold with considerable accuracy.

The trend of this variation suggests that:—(a) the original guano was deposited on the coral base while a slow negative movement of the strand-line was in progress, and no sensible break occurred either in the deposition of the guano, or in the movement of emergence:—(b) subsequent to the deposition of the guano and its conversion into phosphate, the island was tilted at about a third of a degree south-south-eastwards. This supposition is strengthened by the occurrence of raised beaches in the north of the island, and of phosphate *in situ* below sea-level on the south.

A study of similar deposits may help to throw some light on the post-Tertiary movements of the floor of the Pacific Ocean.

DISCUSSION.

Mr. J. F. N. GREEN referred to the interest of the differential movement, proved, he thought, for the first time for one of the smaller limestone islands of the Pacific. There might be significance in the occurrence of thick deposits of phosphate-rock in the Pacific on 'high islands' only, whereas 'low islands' supplied inferior surface-material, presumably owing to shorter occupation by birds. Perhaps a short time ago, geologically speaking, the low-lying islands were under water, which would also account for the late arrival of Man.

The AUTHOR replied that most of the terraced limestone-islands of the Pacific have been noted as approximately 100 metres (328 feet), and Ocean Island conforms to the general rule. Apparently, however, no evidence of slight tilting has been noted before. The reason that all the deposits of any great value occur on such islands may be due to the very uneven surface which a platform of eroded coral offers, the guano being thus trapped in a way that would be impossible on the smooth surface of the low-lying islands. The reasons for the disappearance of the birds are obscure; but it may be noted that the really extensive and older phosphate deposits of the Pacific tend to occur in the west, while the smaller and more recent deposits are found mostly in the east.

Microscope-slides and lantern-slides were exhibited by Mr. H. B. Milner in illustration of his paper; and rock-specimens and lantern-slides by Mr. L. Owen in illustration of his paper.

GENERAL NOTES.

RADIUM IN BRAZIL. DISCOVERY OF A NEW MINE.

Mrs. Alexander Grosse, F.R.G.S., has just returned from Brazil, from an expedition into the interior, where she discovered a radium mine (euxamite radio-active rare earth).

She is the first English (or American) woman to penetrate into these regions. At the base of the mountains is a medicinal lake used by the natives. This lake is radio-active.

Mrs. Grosse is at present in Paris in consultation with Madame Curie.

Times.

CHEMICAL TRADE WAGES. EMPLOYERS' ULTIMATUM.

The Joint Industrial Council for the Chemical Trade met to consider the demands made by the employers for a reduction of wages of 3d per hour, as from February 1. Mr. ROSCOE BRUNNER presided.

The workers' side contested the employers' demand, and urged that the reduction was not warranted, and even if there were grounds for a reduction, then to ask for an amount equal to 12s. a week was unjust.

The employers' representatives stated it was their intention to reduce wages by 2d. per hour on and from February 1, with a further reduction of 1d. per hour on March 1. The workers' side refused to agree, and the meeting broke up, the employers expressing the intention of imposing the reduction.

Times.

Dr. J. S. Haldane, in a recent letter to *The Times*, drew attention to the danger of the use of water gas in domestic lighting on account of the high percentage of carbon monoxide, and suggests that in the interests both of the gas undertakings and of the general public that a thorough investigation should be made into the precautions needed in connection with increasing percentages of carbon monoxide in domestic gas. The results of such an investigation would prove of great value in avoiding future troubles.

THE INSTITUTE OF METALS. IMPORTANT MEETINGS OF THE YEAR.

The annual meeting of the Institute will be held in London on March 8-9, when ten important Papers are to be presented for discussion.

The Annual May Lecture will be de-

livered on May 3 by Sir Ernest Rutherford, F.R.S., on "The Relation of the Elements."

The Autumn Meeting of the Institute will be held—for the first time—at Swansea on September 20-22.

PREVENTION OF CORROSION.—The Institute of Metals has just issued a practical pamphlet of 32 pages giving in summary form the results of over ten years' research into the causes and prevention of corrosion in condenser tubes. The pamphlet, which is one that will appeal particularly to all engineers, can be obtained, price 2s. 8d. post free, from the Institute of Metals, 14, Members' Mansions, London, S.W.1.

The Electric Furnace Spectrum of Scandium, *Astrophysical Journal*, 54, 29-44, July, 1921. The University of Chicago Press, Chicago, Ill.

ABSTRACT.

Spectrum of scandium in arc and in electric furnace. λ 3015 to 6559 Å.—A highly purified sample of scandia, prepared by Sir William Crookes, was placed in a graphite boat in the tube-resistance furnace operated at usual low pressures. The relative intensities of 307 lines on grating spectrograms, obtained with the furnace at a temperature of 2,000, 2,250, or 2,600° C., and with a carbon arc containing scandia, are recorded in Table I., together with the classification of each according to its behaviour in furnace and arc. About 25 lines enhanced in the spark and 150 lines enhanced in the furnace are indicated by E and A respectively. The 29 arc-flame lines are all A lines but are scattered through temperature classes I. to III.; they cannot be due to oxidation, since none took place in the furnace. On the other hand, since the band lines are practically absent from furnace spectra, they are probably due to the oxide. These results are of great interest in relation to solar and sun-spot spectra. The A lines and low temperature furnace lines are absent or very weak in the solar spectrum, but are prominent in the sun-spot spectrum.

Zeeman effect for scandium lines in sun-spot spectra is largely and apparently uniform. Laboratory observations are lacking at present.

Observations as to chemical properties of scandium.—The scandia fused in the furnace seemed to form a carbide with the graphite boat. The shining black residue turned to a gray-brown powder after exposure to the air, presumably from the reabsorption of oxygen. — GORDON S. FULCHER.

MINISTRY OF AGRICULTURE AND FISHERIES. LIQUID MANURE TANKS.

A Dressing of 1,500 gallons of Liquid Manure to the acre is equal to applying 150 lb. of Sulphate of Ammonia and 4½ cwt. of Kalnit.

That such a valuable material should be allowed to run absolutely to waste in the majority of farms is not only a loss to the individual farmer, but to the nation also.

With a view to helping agriculturists who are willing to collect and utilise this important asset, the following suggestions are made for the handling and distribution of Liquid Manure.

It is estimated that the cost of the whole installation would in most cases be recovered within a few years by the saving in artificial fertilisers which it would effect. Both prices and wages are fluctuating so much at present that an financial statement can well be given.

The arrangements needed are of the simplest description, and provided the few important details of construction, described in this pamphlet, receive careful attention, there should be little difficulty either in installing or using the system.

Leaflet No. 382, containing a full illustrated description of the installation, may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries (Publications Branch), 10, Whitehall Place, London, S.W.1.

PHYSICAL AND CHEMICAL SURVEY OF THE NATIONAL COAL RESOURCES

The Fuel Research Board have made arrangements for the recognition of the Lancashire and Cheshire Coal Research Association as the local Committee working under the Board for the purpose of dealing with the physical and chemical survey of the coal seams in this area. The Chairman of the Committee is Mr. Robert Burrows, and the Director of Research Mr. F. S. Sinnatt.

It has long been felt that an important aspect of the great problem of the conservation of the national coal resources involves the study and classification of the coal seams which are at present being worked or developed, and also of seams or portions of seams which are being left unworked or are thrown aside above or below ground. This study and classification

on its directly practical side must deal primarily with the unsuitability of each particular coal for those purposes for which its individual qualities render it most adequate, e.g., for gas making, coke making, steam raising or for domestic use.

This question of survey has for some years been receiving the anxious consideration of the Fuel Research Board, but the unstable conditions which prevailed in the coal industry during and since the war have necessarily led to the postponement of the work of organisation. It is now, however, considered that the time has arrived when a beginning can wisely be made.

The Fuel Research Board believe that this work can be most effectively carried out with the help of local Committees, in which colliery owners, managers and consumers are associated with the representatives of the Fuel Research Board and the Geological Survey. By this combination not only will local knowledge and experience be made available, but the initiative of those most deeply interested in the practical aspects of this Survey will be secured.

The Survey work will thus from the outset assume a practical character, for the selection of seams for examination will be in the hands of those who are in the best position to estimate the relative importance of the problems awaiting solution. The selected seams will be submitted to physical and chemical examination by the local experts; and, as a result of this examination a further selection will be made of those which appear to justify experiments on a practical scale to test their suitability for particular uses or methods of treatment. This experimental work will be carried out either at H.M. Fuel Research Station, or at other works, as may be found most convenient.

The first Committee is already actively at work in the Lancashire and Cheshire district, where the local Research Association has been recognised by the Fuel Research Board as its representative body for the purpose. It is felt by the Fuel Research Board that the experience gained in the work and organisation of this Committee will be of great value in the establishment of Committees in other districts when the time is ripe for further developments, but they are satisfied that it will be wise to build up this national organisation on the sure foundations of actual experience.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

The Denaturation of Alcohol—Jean Effront.—The author has made an exhaustive study of the composition and quantity of the substances commonly used for the denaturation of alcohol. The commonest is methylene, but in some countries pyridine bases are used in addition, and in Switzerland methyl ethyl ketone is employed. There are great variations in the amounts used, and no method has yet been discovered which excludes the possibility of fraud by regeneration. Nor can the alcohol after treatment be regarded as absolutely undrinkable, and the number of people who have acquired a taste for denaturated alcohol is continually growing. The use of saporin can be recommended for alcohol for domestic use. It has the advantage that very small quantities can be easily detected, and its price is very moderate. Objections may be made to it upon the ground of its toxicity, and it might be advisable to employ an emetic with it. (*Moniteur Scientifique*, No. 957, December, 1921).

The Presence of Titanium in the soil M. Geilmann, using Hillebrand's method of determination, has investigated the amounts of titanium in many different specimens of ordinary soils. He found that it was present as cathode in all the specimens. Argillaceous soils are richest in it, then come sandy-argillaceous soils; then sandy and calcareous soils, while in pure lime and sand only traces are present. Titanium is to be found in the ashes of all plants, the maximum amount being detected in the ash of the potato (0.269%). It appears to accumulate in the assimilative organs, which confirms the opinion of Traetta Mosca, who believes that titanate anhydride acts as an oxidising catalyst in plants. (*Journ. für Landwirthschaft*, p. 68, 1920.)

Use of Resorcin in Qualitative Mineral Analysis—M. Lavvy.—In an ammoniacal medium resorcin gives characteristic colourations with many metals, and upon this fact can be based a fairly sensitive method of detecting the presence of these metals. The *modus operandi* is very simple. One cc of a ten per cent. solution of resorcin is added to one cc of a dilute solution of a metallic salt. 2 cc of a ten per cent.

ammonia solution are then added, and the mixture is heated for a moment. The colouration attains its maximum after some hours. Zinc is the most sensitive element; it gives an intense blue colouration, and 0.01 mg of zinc give an appreciative reaction, the liquid turning from yellow to yellowish green and finally to blue. The blue colouration, due to cadmium, is rather less intense. Both manganese and nickel give a blue green colouration, while cobalt gives a reddish violet colour which turns to violet with a little bluish tinge. Copper also gives a blue colour. Mercury salts give no special colouration, but resorcin readily dissolves a precipitate of amido-mercuric chloride, and when the solution is evaporated crystals are obtained which resemble those of caffeine. It is noteworthy that when an acid is added to the coloured solutions containing resorcin the colour changes to red, whatever it was before, and whatever the metal present, while when the coloured solutions are evaporated they give a mass of the same colour as the solution. These colour reactions can be used in analytical chemistry to detect very small quantities of metals. (*Journal de Pharmacie de Belgique*, No. L.II., December, 1921.)

Electrolytic Determination of Antimony—H. Angenot.—The electrolyte usually preferred in order that a satisfactory deposit of antimony may be obtained, is usually a solution of sodium sulphide and potassium cyanide. But it is not possible to obtain a deposit of pure antimony on the cathode; there is always an excess of weight though the exact nature of the impurity has not been ascertained. Various different electrodes have been suggested, and the author has carried out a series of experiments to find which gives the most satisfactory result, comparing the values obtained by electrolysis with those obtained when the potassium bromate method is used. He finds that it is best to carry out the electrolysis at a temperature of about 65° or 70°, using a cathode of platinum foil, the electrolyte being a solution of sodium sulphide saturated in the cold, and 30 per cent. potassium cyanide. In these conditions the percentage of impurity is always approximately the same, and an accurate result is obtained if the weight of the dried antimony is multiplied by 0.9762 for quantities which exceed 10 eg. (*Bull. Soc. Chim. Belg.*, 1921, p. 268.)

Synthesis of Hydrocyanic Acid by Oxidation of Alcohols, Phenols and Amines in an argento-ammoniacal medium—R. Fosse and A. Hénault. If the oxidation of organic substances takes place in presence of ammonia and of a silver or mercury salt hydrocyanic acid can be isolated and estimated. It is also possibly formed as an unstable intermediate product in the respiration of the animal and vegetable cell. Glycerine and formic aldehyde are not the only substances which can yield hydrocyanic acid. Many alcohols, phenols, and amines have the same power, the yields depending upon the nature of the substances and on other factors. Aniline, methylamine, and dimethylamine give large quantities, but when ethylamine is oxidised in the same conditions, only very small amounts of hydrocyanic acid are formed. (*Comptes Rendus, CLXXIV., Jan. 3, 1922.*)

FUEL IN SCIENCE AND PRACTICE.

With the next issue of the *Colliery Guardian* will appear a supplement—to be repeated with the fourth issue in each month—which will constitute a monthly record of British and foreign research regarding the preparation and use of fuel.

The first number will contain a "foreword" by Sir George Boulby, F.R.S., Director of the Fuel Research Board, as an earnest of his interest in this attempt to place before the users of fuel, in its various forms, a periodical account of contemporary research.

The first number, in addition, will include articles by S. R. Illingworth, of the South Wales School of Mines, on "Coal and its Carbonisation"; by Dr. R. Lessing on "The Study of Mineral Matter in Coal"; by F. S. Sinnatt (of the Lancashire Coal Owners' Coal Research Association), and L. Slater, on "Producer Gas from Pulverised Fuel"; and by Dr. R. V. Wheeler (Prof. of Fuel Technology in the University of Sheffield) and R. Wigginton on "Resins in Bituminous Coal." A "Review of Current Literature" will complete the supplement. The supplement will be circulated gratis with the journal or mailed separately to subscribers when desired, and will be edited jointly by Professor Wheeler and Dr. J. V. Elsdon, joint editor of the *Colliery Guardian*.

PROCEEDINGS OF SOCIETIES.

THE OPTICAL SOCIETY.

At a meeting of the Optical Society held at the Imperial College, on Thursday, 12th January, Mr. R. S. Whipple, President, in the chair, the following papers were read and discussed:—

1. "The Manufacture of Optical Glass," by Dr. C. J. Peddle.

The history of the manufacture of optical glass can be divided into four epochs, Guinand's discovery of the stirring process in 1796, the work of Abbe and Schott about 1882, and the development in England during the Great War being the outstanding features in this history. The method of manufacture, which was described in detail, is practically the same at the present time as in Guinand's day, any improvement being one of degree rather than of kind.

For successful production of the various types the effects of composition upon density, refractive index, melting properties, durability, freedom from colour, and devitrification tendencies have to be studied upon a small scale, and the results translated into terms suitable for works practice. Results were given of systematic investigations to determine the relation between composition and these various properties.

2. "The Barr & Stroud 100ft. Self-contained Base Rangefinder." By Dr. James W. French.

Depression, two-position, and more recently self-contained types of rangefinder have been employed for coast defence purposes. The first two types are subject to several disadvantages which have led to the introduction of the 100ft. base self-contained instrument. The rangefinder has a new type of triple field. It is carried upon a mounting comprising two trucks running upon a roller path of 50 feet diameter, the trucks being connected by a rigid horizontal framework. Upon the trucks are carried cantilevers from the ends of which are suspended cradles having special bearings within which the rangefinder rests. Training is done by power or by hand. During extensive tests the uncertainty of observation at a range of 31,000 metres did not exceed 20 metres.

3. "The Optical Three Apertures Problem." By T. Smith, F.Inst.P.

In such an instrument as a submarine

periscope, where broad beams of light have to be transmitted down a long tube from a wide field, the relation between the length and diameter of the tube and the number of lenses was considered. Various types of construction were indicated, together with the relative advantages offered by them.

“PRESENT PROBLEMS OF THE DYE INDUSTRY.”

The Presidential address to the University of Birmingham Chemical Society was delivered on January 23rd, on the above topic, by Professor G. I. Morgan, F.R.S., who, in the course of his remarks, referred to the establishment on a modest scale of the dye industry in England and France by Perkin, Verguin, Nicholson, Gerard and other pioneers. The German colour industry was founded somewhat later, but owing to the closer co-operation of science and industry expansion occurred more rapidly in Germany, in Switzerland, with the result that by 1914 the supremacy of these centres of industrial chemistry was unchallenged.

The industrialisation of indigo was cited as a classical example of the self-sacrificing team work by the aid of what the great German colour firms secured the trade in Alizarin dyes, direct cotton colours, sulphur dyes, and the entirely new vat dyes, discovered at the beginning of the 20th century.

The war showed that the German dye factories were potential arsenals for the mass production of high explosives and of poison gases, inasmuch as the latter materials were almost entirely manufactured by the colour works.

After surveying recent developments in this country, the lecturer emphasised the educational importance of the dyestuffs industry, which in its evolution abroad proved a potent factor in the development of the German chemical industry. The commercialisation of atmospheric nitrogen, the highly profitable trade in synthetic drugs, the production of photographic materials, certain modern metallurgical enterprises, and many other high grade industries have arisen as offshoots in the great colour works. He drew the inference that only by a similar close attention to the synthetic chemical industries could the British Empire be rendered self-reliant in regard to the exploitation of all its chemical resources.

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

LECTURES BEFORE EASTER, 1922.

FRIDAY EVENING DISCOURSES

addressed to members and their friends at 9 p.m.

February 10.—W. D. Halliburton, M.D., LL.D., F.R.S., Prof. of Physiology, King's College, London.—“The Teeth of the Nation.”

February 17.—Dr. S. M. Watson, MSc., Jodrell Prof. of Zoology and Comparative Anatomy, University of London.—“History of the Mammalian Ear.”

February 24.—John Joly, DSc., F.R.S., Prof. of Geology, University of Dublin.—“The Age of the Earth.”

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—“Problems in the Variability of Spectra.”

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—“The Pigments and Mediums of the Old Masters.”

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—“Auxiliary International Languages.”

March 31.—Arthur B. Walkley, B.A., Author of “Drama and Life,” etc.—“Jane Austen.”

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—“Evolution of the Elements.”

January 28.—Dr. C. Macpherson—“The Evolution of Organ Music.”

January 31.—Prof. H. H. Turner—“Variable Stars.”

February 2.—Sir Napier Shaw—“Droughts and Floods.”

ROYAL INSTITUTION.—Saturday, Feb. 4: Prof. E. de Selincourt, *Humorists of the Seventeenth Century*, 3; Monday, Feb. 6: General Meeting, 5; Tuesday, Feb. 7: Prof. H. H. Turner, *Variable Stars*, 3; Thursday, Feb. 9: Sir Napier Shaw, *Droughts and Floods*, 3; Friday Evening, Feb. 10: Prof. W. D. Halliburton, *The Teeth of the Nation*, 9.

THE GEOLOGICAL SOCIETY

The Annual General Meeting of the Society will be held at the apartments of the Society in Burlington House, on Friday, February 17th, at 3 p.m.

After the official business, the President's address will be delivered.

The anniversary of the Society will be celebrated by a dinner at the Criterion Restaurant in the evening.



This list is specially compiled for *Chemical News* by Messrs. Beeson & Co., Registered Patent Agents at 1, Chancery Lane, London, from whom all information relating to Patents, Trade Marks and Designs can be obtained gratuitously.

Latest Patent Applications.

- 444,111—Barber, T. W.—Recovery of colloidal matter from liquids. Dec. 22.
- 448,511—Cler, C.—Manufacture of magnesia from dolomite. Dec. 20.
- 342,719—Thermal Industrial and Chemical Research Co.—Distillation of tar. Dec. 20.
Specifications Published this Week.
- 172,387—Douglas, R. P.—Apparatus for use in the manufacture of sulphate of ammonia.
- 159,156—Kaltenbach, M. H.—Process for the manufacture of sulphuric acid.
- 149,913—Brüllins, M.—Apparatus for chemical production and research.
- 134,362—Soc. D. Indes Chimiques Pour l'Industrie.—Process for the manufacture of a mixed material containing a variable amount of nitrogen and phosphates.
- 172,390—Brougham, F. J.—Process of and apparatus for separating finely-divided minerals from their ores by froth flotation.
- 172,431—Lirkman, H. E.—Process and furnace for the reduction of metallic oxides.

Abstracts Published this Week.

549,600—Eid.—Patent No. 170,880.—A new method of obtaining sulphuric acid has been invented by Mr. A. Matheson, of 146, Bishopsgate, London.

The acid is obtained by calcining alunite and passing the evolved gases over the cooler parts of the alunite which by reason of the catalytic effect of the iron oxide it contains effects and recombination of the sulphur dioxide and oxygen. The calcination may be performed in any closed type of furnace in which the dilution of the gases with air or furnace gases is avoided, but preferably one is used in which the crushed material fed in at the top is mechanically passed down a series of hearths the bottom one of which is heated by external means to a temperature of 760-900°C. The cooled gases pass on to a condenser, and the effluent water in the form of steam or a spray to form sulphuric acid is injected either into the furnace or into the condenser.

NOTICES.

EDITORIAL. All literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the Editor.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3226.

FEDERATION OF BRITISH INDUSTRIES.

The attached letter, dated 2nd February, 1922, has been sent to the Postmaster-General:—

Sir,—The Federation of British Industries have for some time had under consideration the grave effects upon the industrial community of the present heavy charges for postal, telegraph and telephone facilities.

They fully realised the difficulties which confronted the Post Office as a consequence of the war, and have hitherto been reluctant to press any general criticism, confining themselves to bringing to your notice, or to that of your officials, specific difficulties and causes of hardship or inconvenience as they arose.

Sufficient time has, however, now elapsed since the Armistice to permit of any necessary reorganisation of the postal and other services under the charge of your Department. A considerable reduction in the cost of materials has taken place, and the general fall in the cost of labour which has accompanied the fall in the cost of living should not have been without its effect on the expenses of a Department which is a large employer of labour.

Under these circumstances, the Federation feel that it is not inopportune to urge on you the importance of reducing charges which are a severe handicap to the revival of trade, and they were glad to notice a statement by you in the Press to the effect that the Post Office should not be regarded as a revenue-earning Department, but that any surplus which might occur in the Post Office balance sheet would be reflected in a reduction of the charges to the public.

They notice with regret your statement in the *Observer* of January 22nd, that you do not anticipate a surplus in the Post Office accounts as a result of the present year's working, but trust that you will be able, in framing your estimates, to anticipate such substantial economies in the forthcoming year as to permit at least the immediate reduction of the more onerous charges, and a further progressive reduction throughout the year in all the charges.

The Federation would urge that particular attention should be given to a prompt re-

duction of the postcard and printed paper rates, which not only most seriously affect the printing industry as producers, but also affect every other industry as consumers. In making this request, the Federation desire to support most emphatically the representations which have already been addressed to you on this subject on behalf of the printing trade. If, as they understand, the inland printed paper rate is not at present remunerative on account of the elaborate sorting which it entails, they consider that serious attention should be devoted without delay to the simplification of the regulations governing the postage of printed matter, in order that the expense of sorting may be reduced.

In addition to the reduction of rates, the Federation would desire also to urge upon you that the collection of letters on Sunday might be resumed. It is an undoubted fact that the abandonment of the Sunday collection seriously delays the work of many businesses on the Monday, and consequently tends to dislocate the whole business arrangements of the earlier part of the week. This difficulty is rendered the more serious, as the Federation are assured that in many parts of the country there are serious delays in Saturday deliveries.

The Federation have refrained from making any suggestions with regard to the Telephone service in this letter, as they realise that you are still awaiting the Report of the Select Committee of the House of Commons, which has been considering the question. They are confident that the Committee's recommendations will enable you to make substantial economies in the working of the service, and they trust that these economies will be reflected in reduced rates.

In conclusion, the Federation wish to emphasise the pressing need to Industry of sympathetic consideration of these suggestions in the present difficult times, and to express the hope that you will be able to announce at an early date that you are proposing to offer early relief from the existing high rates charged by the Post Office for its services.

I am, Sir,

Your obedient servant,

R. T. NUGENT.

Director.

The Rt. Hon. F. G. Kellaway, M.P.,

Post Office,

St. Martins le Grand,

E.C.1.

Contribution from the Department of
Chemistry, Cornell University.
**GERMANIUM III. GERMANIUM
TETRABROMIDE AND GERMANIUM
TETRACHLORIDE.¹**

BY L. M. DUNN AND W. E. HANCE.

A. GERMANIUM TETRABROMIDE.

Winkler² prepared what he assumed to be germanium tetrabromide by heating germanium in vapour of bromine, and also by heating a mixture of pulverised germanium and mercuric bromide. He stated the product to be a mobile, fuming liquid which solidified at 0°C., or slightly below that temperature to a white crystalline mass. He did not analyse or make further study of the compound because of lack of material.

The present investigation describes the preparation and further study of this substance.

Material.

Germanium was prepared in finely-divided form by reducing germanium dioxide in a current of hydrogen at temperatures between 550°C. and 600°C. Toward the end of the reduction the temperature was raised to 900°C.

Bromine was purified by first digesting it with calcium bromide and zinc oxide,³ then distilling off the bromine, converting the middle fraction to hydrobromic acid by treating it with sulphur dioxide in the presence of water, distilling off the hydrobromic acid, and liberating the bromine from this by means of pure manganese dioxide. This bromine was re-distilled, was next dried over phosphorus pentoxide, and was then again distilled. The middle fraction was used.

Preparation of Germanium Tetrabromide.

Powdered germanium was placed in alundum boats which were inserted into a tube of Jena glass lying in an electric combustion furnace. A thermometer was laid in the combustion tube alongside the boats. To the front end of this tube was attached an inverted T tube. The upright arm of the T tube was sealed to a separatory funnel containing bromine. The further end of the T

tube was joined to a chain of apparatus supplying purified nitrogen. The exit end of the combustion tube was brought well within a long adapter which in turn was fused to the inlet tube of the first of two small, all-glass distilling bulbs.⁴ The side arm of the second bulb was connected with a U-tube containing calcium bromide, and this to a water suction-pump and manometer.

In beginning the procedure, nitrogen was started flowing slowly through the apparatus. Slight diminished pressure was maintained throughout the run by suitable adjustment of the suction pump. When the whole apparatus was filled with nitrogen, bromine was slowly admitted into the T tube. A small alcohol lamp placed beneath this tube hastened the volatilisation of the bromine. A freezing mixture of ice and salt was brought up around the bulb that served as the first receiver.

Reaction between the bromine and germanium began at once in the unheated tube (26°C), small, colourless globules of oily liquid appearing on the inner surface of the tube. Combination of the two elements apparently ceased after a short time, and vapour of bromine passed over into the receiver. The temperature of the tube was then slowly raised. At 180°C. slow union again was discernible. At 220°C. germanium bromide was rapidly produced, and it was found that bromine could not be admitted at the rate of 20 drops per minute without any appreciable amount of it escaping combination with the germanium. The temperature was maintained at 220°C. until the interaction apparently had ceased and free bromine appeared in the receiver. During the experiment, an oily liquid had steadily passed over, and had collected entirely in the first of the receiving bulbs. The admission of bromine was now stopped and the apparatus was allowed to cool in the current of nitrogen. During this interval the distillate in the cooled receiver solidified to a yellowish white solid.

There remained in the alundum boats a greyish white residue which proved to be chiefly germanium dioxide. The reasons for its occurrence here will be discussed in a later article.

The flask containing the distillate was disconnected from the chain, a U-tube filled with calcium bromide was attached to the side-arm, and the neck of the flask was tightly stoppered. The contents was

¹ See Dennis and Bridgman, this Journal, 40, 1543, Fig. 5, 1918.

¹ The investigation upon which this article is based was supported by a grant from the Heckscher Foundation for the Advancement of Research, established by August Heckscher at Cornell University.

² J. prakt. Chem. 144 (New Series 36) 193, 1887.

³ Further details concerning this reaction will be given in a later article.

⁴ Richards and Merigold, Am. Acad. Arts and Sci., 37, 387 (1901-2).

warmed until it melted, and about 2 cc. of mercury was then introduced. Agitation of the flask soon removed the free bromine, and the supernatant liquid became clear and colourless. Later analysis showed that the product is germanium tetrabromide. Before making the analysis to establish its identity, the liquid was purified by fractional distillation and its boiling point was determined.

The germanium tetrabromide was siphoned off from the mercury into a dry distilling flask, the substance being carefully protected from moisture during the transfer. It was then twice distilled, but a sample of the second distillate showed on spectroscopic examination the presence of a slight amount of mercury. For this reason a second preparation of the germanium tetrabromide was prepared, and from this the free bromine was removed by repeated fractional distillation instead of by the use of mercury. A large middle fraction that passed over at about 183°C. was then used for the determination of the boiling point, and 71 readings, taken at one minute intervals, gave a constant boiling point of 183.0°C., the total weight of the germanium tetrabromide that distilled over at this temperature being 97.47 grams. The corrected boiling point was then calculated according to the formulæ given by Young.¹ There is no formula that is generally applicable to the accurate correction of the observed boiling point to that under standard pressure. Young states that quite precise results are, however, obtained by the use of the formula $\theta = K(760 - P)(273 + t)$. Provided the value of the constant K is determined experimentally, θ is the correction in Centigrade degrees to be added to the observed boiling point t , and P is the barometric pressure corrected to 0°C. Young gives the value of K for several substances, among which are silicon tetrachloride and tin tetrachloride. He further states that the value of the constant is not altered by replacing one halogen by another. Inasmuch as germanium lies between silicon and tin in the fourth group of the periodic table, the value of K for germanium tetrachloride and germanium tetrabromide may be assumed to lie midway between the value for silicon tetrachloride, 0.000126, and that for tin tetrachloride, 0.000121. The boiling point of germanium tetrabromide thus corrected is 185.9°C.

Analysis of Germanium Tetrabromide.

Portions of about two grams each of the substance were introduced into small glass

capsules of known weight and the capsules were then sealed and weighed again. A capsule was broken under absolute alcohol and the solution was diluted to 250 cc. with absolute alcohol. Two portions of this solution were used for the analyses. The bromine was determined by precipitation as silver bromide. The filtrate was freed from silver by the addition of hydrobromic acid in very slight excess. The silver bromide was filtered off, concentrated hydrochloric acid was added to the filtrate until the acidity was 6N and the germanium was then precipitated by hydrogen sulphide. The germanium sulphide was washed with alcohol, was then oxidised with nitric acid, was ignited at red heat to constant weight, and was weighed as germanium dioxide.

In calculating the results of the analyses, 72.5 was used as the atomic weight of germanium.

Wt. of GeBr ₄ .	Weight of Ge Found.	Weight of Ge Calc.	Weight of Br. Found.	Weight of Br. Calc.
0.2158	0.0403	0.0398	0.1753	0.1759
0.2158	0.0399	0.0398	0.1756	0.1759

The results of the analyses, while not in close accord with the theoretical, suffice to establish the identity of the substance as germanium tetrabromide.

The Melting Point of Germanium Tetrabromide.

About ninety grams of germanium tetrabromide of constant boiling point was brought into a large test tube and its melting point was determined with the aid of an Anschütz thermometer that had been calibrated by the Bureau of Standards. The observed melting point was 26°C. The corrected melting point was 26°C.

The Crystal Form of Germanium Tetrabromide.

A crystallographic examination of the substance was kindly made for us by Professor A. C. Gill, of the Department of Mineralogy. Inasmuch as the substance could not be exposed to the air during observation under the microscope, a sample of about one cc. was sealed in a thin-walled glass tube and was cooled therein until it crystallised. The crystals were found to be brilliant, white, flattened octahedrons, which under polarised light proved to be isotropic, which indicates that they belong to the regular system.

The Index of Refraction of Germanium Tetrabromide.

An approximate determination of the index of refraction was first made, using a

¹ Fractional Distillation, pp. 12 and 14.

microscope. Ahiel condenser, and prismatic system. The germanium tetrabromide was placed in a small brass cell that was mounted on a cover glass. The cell was first calibrated with water, oil of cedar, and oil of mass. The approximate value for the refractive index thus obtained was 1.61.

More accurate determinations of the index of refraction were then made with an Abbe refractometer. The super-cooling exhibited by germanium tetrabromide made it possible to make a series of readings at temperatures below the melting-point of the substance.

Temperature	Index of Refraction
20.7°C.	1.6296
21.10°C.	1.6292
22.20°C.	1.6285
23.00°C.	1.6274
24.50°C.	1.6272
25.20°C.	1.626

Index of Refraction of Germanium Tetrabromide at 25°C. = 1.6265.

Gravity

The Specific Gravity of Germanium Tetrabromide

A pycnometer of 10 cc. capacity was dried over phosphorus pentoxide, and was then quickly filled with germanium tetrabromide. The measurements were made at 29 to keep the substance in liquid state. At this temperature, the specific gravity of GeBr_4

$$= 3.1315.$$

29

The Electrical Conductivity of Germanium Tetrabromide

An alternating current, 1,000 cycles per second, 6 volts was used. Resistance was measured by a Wheatstone bridge with telephone attachment. A conductivity cell of 18cc. capacity, and 90mm. between platinum electrodes, was filled with germanium tetrabromide and was at once sealed to prevent contact with the moisture of the air. The cell was placed in a bath that was maintained at a constant temperature of 30°C. A resistance totalling 300,000 ohms was found to be insufficient to balance the resistance of the cell. This shows that the Specific Conductivity of germanium tetrabromide is less than 0.000078 reciprocal ohm.

Chemical Properties of Germanium Tetrabromide.

In the liquid form germanium tetrabromide is a colorless, mobile liquid which fumes when brought in contact with the air. It shows to a marked degree the property of super-cooling, and it was found that the liquid when not agitated could be chilled to a temperature of -48°C. before it solidified. The substance crystallizes in minute white octahedrons. This crystalline mass gradually changes on standing into a clear, hard, transparent, glass-like material with fractures running through it like the fissures in a temp. of cracked glass.

When a few drops of water were added to about 1cc. of liquid germanium tetrabromide, hydrolysis at once took place with the evolution of heat. A layer of hydrated germanium dioxide formed at the surface, and if the tube was not agitated, two liquid layers appeared below this solid crust. The lower layer consisted of unchanged germanium tetrabromide and the upper layer of a suspension of germanium hydroxide.

When a drop of germanium tetrabromide was allowed to fall into water, a small white ring of hydrated germanium dioxide was formed and further deposit of the white hydroxide around the circumference of this ring rapidly built up.

In one experiment 25 grams of germanium tetrabromide was poured into 50cc. of water. The tetrabromide sank to the bottom of the tube, and at the surface of contact between the two liquid layers there was rapidly formed a heavy film of germanium hydroxide. Above this film there gradually appeared a fine suspension of this substance. The layer of germanium hydroxide protected the tetrabromide below it from further hydrolysis for more than 24 hours, the hydroxide forming a tough impervious stratum. The water above this layer of germanium hydroxide gradually cleared up and this clear solution gave a decided acid reaction to litmus. When germanium tetrabromide is dropped into water, there is noted a slight but distinct crackling sound. It is scarcely audible, and it would probably have escaped attention were it not for the fact that a similar phenomenon had already been noticed when germanium tetrachloride and water are brought together.

When a few drops of germanium tetrabromide were allowed to fall into 2cc. of concentrated sulphuric acid, the substance sank to the bottom of the tube and no reaction nor visible change took place during the several days that the tube was allowed to stand at room temperature. This behaviour is similar to that of the tetrachlorides of tin and lead, elements which lie below germanium in Group 4 of the Periodic Table.¹

When germanium tetrabromide was introduced into a aqueous solution of potassium hydroxide (1:4), reaction took place at once with the evolution of heat. Germanium hydroxide first separated and then quickly dissolved in the alkali. When carbon dioxide was passed through this solution of potassium germanate, a heavy white precipitate resulted.

When germanium tetrabromide was dropped into concentrated nitric acid, it fell to the bottom of the tube and gradually took on a deep orange colour. The nitric acid above the tetrabromide became yellow and turbid and was rapidly reduced. The layer of germanium tetrabromide soon took on a dark brown colour and a disk of white germanium oxide formed between the two liquid layers. After about fifteen minutes the colour of the tetrabromide changed to black and the reaction between it and the nitric acid went on slowly with copious evolution of nitric oxide. After the reaction had ceased, water was added to the contents of the tube, whereupon there formed a precipitate that appeared to consist of white powder, a yellow substance, and the black amorphous precipitate previously mentioned. The supernatant liquid was clear and of a pale yellow colour. After standing for twenty-four hours, the precipitate in the bottom of the tube became entirely white.

With dry ammonia gas, germanium tetrabromide formed a white solid compound which is probably analogous to the corresponding compounds of ammonia with the tetrabromides of silicon and tin. This substance is now being subjected to further study.

Germanium tetrabromide was found to be soluble in absolute alcohol, carbon tetrachloride, benzene, and ether without decomposition. It dissolves in acetone, but slow decomposition takes place with the liberation of bromine.

SOCIETY OF GLASS TECHNOLOGY.

A meeting of the Society of Glass Technology was held in the Applied Science Department, The University, Sheffield, on January 18th, 1922, the President, Dr. M. W. Travers, F.R.S., in the chair.

After an announcement by the President as to the forthcoming visit to this country of the American Ceramic Society, probably in September, a general discussion took place on the subject of "The Durability of Glass." The first paper presented was "An Examination and Extension of Zulkowski's Theory of the Relation between the Composition and Durability of Glass," by W. L. Baillie, A.I.C. In the absence of Mr. Baillie an abstract of the paper was given by Prof. W. E. S. Turner, who said that Zulkowski's theory was based largely on direct chemical evidence. It assumed that, in the founding of glass, the essential reactions involved were, primarily, the formation of simple silicates of the alkalies and alkaline earths, and that subsequently these bodies combined to form double silicates which were regarded as the characteristic constituents of all serviceable glassware. This second reaction was the slower, and it would not proceed to completion unless the melt was maintained at a sufficiently high temperature for an adequate period. In all these reactions the bases were regarded as competing equally for the acids, and it was further assumed that all the materials of the batch entered completely into reaction. If one type of base, alkali or lime, be molecularly in excess, simple silicates would remain in the glass, and would persist irrespective of fining. These simple silicates were regarded as the prime cause of instability.

If a glass had the molecular composition:

SiO ₂	a per cent	(a+b) molecules
R ₂ O ₃	b per cent	per cent of
RO	c per cent	acidic oxides
R ₂ O	d per cent	

when a sum of the bases was greater than three times the molecular proportion of R₂O₃ oxides, it was proposed to regard the R₂O₃ oxides as combining to form boro or aluminosilicates, which may be formulated as 3b MO, bR₂O₃, n SiO₂. There was now a residue of bases amounting to (c+d-3b) molecules, and of SiO₂ amounting to (a-n) molecules. On the assumption that the bases were propor-

¹ Friedrich: Ber. 26, 1434 (1893).

(To be Concluded Next Week.)

tionally distributed among the silicates and simple silicates. The individual residues of 100 and 4220 bases would be proportional to the amounts originally present, and so

Residue of 100 bases $(c+d-3b)$ molecules.

$(c+d)$

Residue of 100 bases $(c+d-3b)$ molecules.

$(c+d)$

Following Zerkowski's original theory, the bases contained in simple silicates would amount to $(c+d-3b)$ molecules.

$(c+d)$

The difference between Zerkowski's original theory and that now proposed lay essentially in the different quantities defined by the number of molecules of simple silicates. By the former theory the positive result was obtained, to which the term "basic reserve" was applied. The theory proposed gave the more complete formula

$(c-d)(c+d-3b)$

$(c+d)$

for which the term "reactivity coefficient" was suggested.

Zerkowski's original theory failed to explain the durability of glasses containing any considerable proportion of Al_2O_3 and H_2O . The agreement between calculated and observed reactivities by the proposed theory, was generally as good as in the case of the simpler types. In general, glasses of satisfactory resistance were found to have reactivity coefficients of under three units, and the best commonly had values of two units or less. Negative values were generally associated with the most stable glasses, though very large negative values were notably undesirable. Glasses whose coefficients exceeded five units were unstable for chemical ware.

The second paper presented was entitled, "A Critical Note on the Methods of Determining the Durability of Glass," by Prof. W. E. S. Turner, D.Sc. Prof. Turner said that there were a number of methods possible, but he proposed to discuss only a few of those in fairly general use. Dealing first with the expression of the results obtained, the method of stating the loss in weight due to the attack of reagents, was not a reliable check. It was better, where possible, to determine the amount of alkali liberated. With regard to the form of the test pieces, flasks gave different results from beakers, especially where the temperature was such that volatile reagents or vapours caused action. Also, as flasks differed in shape, the area of the liquid in contact

differed for definite weight or volume of the reagent; while pieces immersed appeared to give results different from those obtained where one surface only was in contact with the reagent. Four modes of test were indicated:—(a) The Static method—with flasks and beakers, (b) The use of slabs and discs immersed in the reagent, (c) The Autoclave test, (d) For convenience and rapidly a good method was that of using glass, ground up to mesh 20 to 30, though Dr. Peddle advocated the 160 mesh.

The whole subject, however, was one requiring careful investigation, and in the speaker's opinion it was one which could be most appropriately dealt with by the Glass Standards Committee of the Society.

A third paper, "The Effect of Magnesia on the Durability of Glass," by Miss C. M. M. Muirhead, B.Sc., and Prof. W. E. S. Turner, was presented by the latter. In this paper a comparison was made of the results obtained from the action of certain reagents on lime glasses, and on magnesia glasses. Resistance to attack by water was determined from tests made on glass crushed to mesh 20-30, and boiled for 1 hour. The amount of sodium oxide set free was greater in the case of the lime glasses than in the case of the magnesia glasses. The results of tests on boiling discs in hydrochloric acid for 6 hours showed that a glass containing small amounts of magnesia was much more resistant than the corresponding lime glass. The effect of increasing the amount of magnesia was not so marked as the effect of increasing the lime. Magnesia glasses were found to be less resistant than lime glasses to attack by both sodium carbonate and caustic soda, after boiling for three hours. It was also found that the loss in weight for sodium carbonate was greater than the loss in weight with caustic soda.

Taking the whole subject of corrodibility in a general way, there was not much difference between the lime and the magnesia glasses. One set held the advantage towards one particular reagent, and the other set held the advantage towards another reagent.

The papers elicited a lively discussion, in which there took part the President, Messrs. F. W. Adams, A. Bunce, F. G. Clarke, J. R. Clarke, E. A. Hailwood and W. J. Rees.

The President intimated that the next meeting would be held in Manchester on February 15th, when part of the time would be devoted to questions.

NOTES ON BOOKS.

Synthetic Tannins, their synthesis, industrial production, and application, by GEORG GRASSER, DR. PHIL. ING., translated by F. G. ENNA; CROSBY, LOCKWOOD & SONS, 7, Stationers' Hall Court, Ludgate Hill. Price 12/- net.

The author has held the appointment of technical consultant to the Austrian Leather & Hides Commission, and in this capacity was called upon to act as general adviser to the trade. The importance of synthetic tannins and their use will help to make the industry independent of foreign productions.

In the translator's preface it is stated that the number of substances patented by German chemists for the production of synthetic tannin materials was almost staggering, and the translator has done a public service in bringing the work of Dr. Grasser to the hands of the British leather industry.

The book opens with an introduction to the classification of tannins and the chemistry of tannin materials. A good chapter is devoted to the production and application of tannins and the chemical examination of leathers that have been tanned by various processes. The book is purely technical in its character, and will be found indispensable to the chemists of the leather industry. There is an index of authors' names as well as of subjects.

Critical Microscopy How to get the best out of a Microscope, by ALFRED G. COLES, M.D., with illustrations. London, J. A. CHURCHILL. Price 7/6 net.

This is a thoroughly practical book by an Englishman, upon the English microscope. The author states that the English-made microscope of to-day is an instrument of precision, and that some British models have never been equalled by any of the best Continental manufacture.

The first portion of the book deals with a description of the microscope, its objectives, condensers, eyepieces and other details. This is followed by a very valuable section on the manipulation of the microscope and its accessories, and full details are given of the author's method of making stained preparations, micrometry and photo-micrography. Very complete photographic illustrations are given of the arrangements of apparatus for use.

It has recently been pointed out not only

in the Faraday Society, but in the Society for Glass Technology, and other similar institutions, that the microscope can be made of the greatest value in almost any industry, and a practical work of this description will be found of the very greatest use to anybody who proposes to use this means of investigation.

THORIUM IN MONAZITE SAND.

The *Journal of the American Chemical Society*, No. 9, Vol. 43, for September, 1921, gives a detailed account of a novel method, by Homer H. Helmick, for the determination of Thorium in monazite sand by means of its emanation. Full descriptions and illustrations are given of the working details, and the results show that analyses by this means will give results that agree very closely with those obtained by gravimetric methods, and requires very much less time for the determination.

The November issue of the same journal contains an account of a scheme for separating Columbium and Tantalum by means of selenium oxychloride, by Henry Baldwin Merrill. The paper in question is a portion of a thesis presented to the university of Wisconsin. The previous methods for separation are reviewed, and full details are given of the new reaction. Numerical particulars are recorded of results obtained by the application of the method to the separation of synthetic mixtures of Tantalum and Columbium pentoxides, which show great accuracy. The paper is followed by another upon the separation of Molybdenum and Tungsten, by the same reagent.

FUEL IN SCIENCE AND PRACTICE.

"Fuel in science and practice" is the title of a new journal devoted to the science and economic use of fuels, being the record of the Coal Research Club.

The journal opens with a foreword by Sir George Beilby, F.R.S. Sir George gives the reason for the appearance of the publication and emphasises its importance.

The following important articles are given in the issue: The first by Messrs. F. S. Sinnatt & L. Slater, on Producer Gas from pulverised coal. Coal and its carbonisation, by Sir Roy Illingworth. The Study of Mineral Matter in Coal, by Dr. R. Lessing. Resins in Bituminous Coal, by R. V. Wheeler and R. Wigginton. The articles are all of thoroughly practical value in connexion with fuel science. Then follows a review of current literature and a monthly bibliography of the literature of fuel.

The journal is to be published on the fourth Friday in each month. Annual subscription 10/6, post free. Communications to be addressed to the Manager, 50 & 51, Farnwell Street, Holloway, E.C.4.

A French-English Dictionary for Chemists, by ALBERT M. PATTERSON, Ph.D., formerly editor of *Chemical Abstracts*. New York, JOHN WILEY & SONS; London, CHAPMAN & HALL, LTD.

The author's *German-English Dictionary for Chemists* has proved of such value that it was decided to republish the *French-English Dictionary* on the same lines. The object of the work is to meet the need of the practical chemist, and it is more than a mere collection of words with their English equivalents. A large number of phrases have been introduced. At the commencement of the book there will be found a number of typical regular verbs, which will save reference to a grammar. A general vocabulary has been included with the technical words, and no pains have been spared to make the work of real value to chemists and physicists generally. It is well printed and in convenient size for the desk, and the price of 18/- is very reasonable.

Biological Chemistry, by H. E. REAR, M.D., D.Sc., M.R.C.S., L.R.C.P., Professor of Physiology at London Hospital Medical College, University of London. Pp. xvi.+216, fully illustrated. London, HARRISON & CO., LTD. Price 10/6 net.

The object of this work is to give the student a general survey of the various chemical processes which take place in living organisms.

The book is divided into three sections. The first section is devoted to introducing the reader to the subjects of organic and physical chemistry, so that the problems dealt with subsequently can be duly appreciated. The author has been very successful in his treatment of the latter subject, but the chapter on organic chemistry is not so satisfactory as the treatment of the elementary conceptions of this subject will not meet the requirements of those unfamiliar with this branch of chemistry, it seems probable that the author would have been better advised to have assumed that his reader possessed an elementary knowledge of organic chemistry. Sections two and three deal with the problems associated with anabolism and catabolism respectively. The treatment of these subjects is accomplished

in a very interesting manner, but as usual the catabolic changes receive more attention than those of an anabolic nature. On one page the following statement occurs—'all living cells can synthesise, but not all cells can store radiant energy. . .'. Surely it is usual to regard living cells as transformers rather than as synthesisers of energy!

The book contains certain features which deserve special mention. At the end of each chapter a list of the works which deal with the subject matter of the chapter in greater detail is given, and the references to the literature are given at the foot of each page, so that the original work can be consulted when necessary, but the inclusion of the usual list of "Literature Abbreviations" has been overlooked.

Unfortunately, the book contains several printer's errors, but a matter of more serious consequence is the fact that the numerous excellent diagrams and tables have not been satisfactorily incorporated into the text.

Nevertheless, despite the shortcomings referred to above, the book can be recommended as a good introduction to this fascinating subject.

F. L. S.

A Study of Arc-Cathode Spectra, *Astrophysical Journal*, 54, 65-75, July, 1921. The University of Chicago Press, Chicago, Ill. By Arthur St. C. Dunstan and Benjamin A. Wooten.

ABSTRACT.

Arc spectra; relative intensity of metallic lines at anode and cathode.—A series of experiments were performed to test various suggested explanations for the fact, amply verified by the authors, that metallic lines are always stronger at the cathode when the metal is introduced symmetrically. A horizontal arc inclosed in a furnace was fed with metallic vapour (Sr, Ba, Li, Cu or Pb) supplied by an alternating current arc 5 cm below. Water-cooling either electrode had no effect, and attempts to obtain separation of the vapours electrolytically or by electrostatic action failed. The spectrum of a 60-cycle alternating current arc taken through a rotating sector synchronized to transmit light during only half of each cycle, was the same as that of a direct current arc. This proves that the phenomenon is fully developed in 1/120 second, and makes it unlikely that it is due to the transference of the vapour from one electrode to the other

either thermally or electrically. When small pellets of metallic salt were dropped through the arc, the spectrum lines were fish-shaped with the heads towards the cathode. The evidence as a whole indicates that the light is due chiefly to bombardment of the metallic vapour by electrons from the cathode.

Variations with atomic weight.—In general the ratio of cathode to anode intensity was found to decrease as the atomic weight increased.—GORDON S. FULCHER.

BOOKS RECEIVED.

"Organic Chemistry or Chemistry of the Carbon Compounds," Victor von Richter. Pages: xvi.-760. George Routledge & Sons, Ltd., Broadway House, 67-74, Carter Lane, Ludgate Hill, London, E.C. 4, 1922. Price: 35/- net.

"Confectioners' Raw Materials," James Grant, J.P., M.Sc.Tech., F.I.C., F.C.S. Pages: V.-173. Edward Arnold & Co., 41 & 43, Maddox Street, London, W., 1921. Price: 8/6 net.

"The Measurement of Steady and Fluctuating Temperatures," R. Royds, M.Sc., A.M.I., Mech.E. Pages: XI.-162. Constable & Company, Ltd., 10, Orange Street, Leicester Square, W.C., 1921. Price: 16/-.

PREPARATION OF TUNGSTEN.

The *Journal of the Australasian Institute of Mining and Metallurgy*, No. 43, for September, 1921, contains a valuable paper upon the preparation of Tungsten and the assays of low grade ores, by Herbert Lavers, A.S.A.S.M. The paper is a very valuable contribution to the history of the chemistry of Tungsten, and is intentionally bound in such a manner that it can be easily detached from the journal if desired.

ROYAL INSTITUTION.

Saturday, Feb. 11., Prof. E. de Selincourt: *Humorists of the Seventeenth Century*, 3. Tuesday, Feb. 14, Prof. H. H. Turner: *Variable Stars*, 3. Thursday, Feb. 16, Prof. A. G. Perkin: *Dyeing, Ancient and Modern*, 3. Friday Evening, Feb. 17, Dr. S. M. Watson: *History of the Mammalian Ear*, 9.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Detection of Small Quantities of Pyridine.—(A. Goris and A. Larssonneau).—In presence of cyanogen bromide pyridine combines with aniline, giving the bromide of anilido-phenyldihydro-pyridinium, which is a red crystalline substance, fusing at 162°. If 5-10 cc of recently prepared cyanogen bromide are added to a mixture of a drop of pyridine, a drop of aniline and 1 or 2 drops of water, an intense red colouration appears at once, and a precipitate of crystalline needles is formed. The reaction is very sensitive, and the colouration is easily seen, even when the dilution is $\frac{1}{400,000}$; in this

case, however, the liquid is first yellow, turning orange after about half-an-hour, while in from 24 to 48 hours drops of a red oil separate. No reaction is obtained with pyrotic derivatives such as α -methyl-pyrrolidine, and hence the production of this colouration may be used to detect pyridine in presence of these bases. (Bul. Sc. Pharmacol, 1921, p. 497.)

Synthesis of Camphor.—(E. Witte).—All methods of synthesising camphor start from the same substance. The chief stages in the transformation are as follows:—(i.) Pinene hydrochloride is obtained by the action of hydrochloric acid, and is purified; (ii.) camphene is obtained by eliminating two molecules of hydrochloric acid from pinene hydrochloride by means of mineral or organic bases or salts of weak acids. There are many different ways of bringing about this transformation; (iii.) isoborneol acetate is obtained by the action of sulphuric acid upon an acetic solution of camphene; (iv.) Borneol is obtained by the isomerisation of isoborneol by means of the alkaline or alkaline earth metals; (v.) camphor is the acetone of borneol and the oxidation can be effected in many different ways, such as by the use of nitric acid. These processes can be modified, as, for example, by transforming pinene hydrochloride directly into isoborneyl, either by the action of fatty acids in presence of zinc chloride. Camphene can also be transformed directly into camphor by oxidation. (Chem. Ztg., 1921, p. 118.)

Tetrahydronaphthalene "Tetralin" in Combustion Engines.—(E. de Gramm).—Tetrahydronaphthalene or "tetralin" can

be obtained by the treatment of purified naphthalene with hydrogen in presence of nickel. It is a colourless liquid, with a characteristic smell, boiling at 205° , freezing at -20.5° . In physical properties it is intermediate between naphthalene, benzene and petrol, resembling the last in its density, its resistance to acid, and its high melting point (20°). Unlike petrol, though it gives very gentle explosions, and has no tendency to catch fire. It possesses two great advantages: a high specific gravity (0.73), and a calorific power which is also high in proportion to the weight, viz. 11,000 calories per kilo, while that of petrol is only 11,000 calories. In proportion to the volume the calorific power (11,000 calories per litre) is much higher than that of petrol (7,500 calories per litre), as even benzene (8,500 calories per litre). Tetralin cannot be used alone, but gives the best results when mixed with an equal volume of benzene. This mixture can be mixed with alcohol, while tetralin alone does not give a satisfactory mixture with alcohol. (*Reine des Produits Chimiques*, 1921, 1021, p. 729.)

Mixed Organo-metallic Compound of Aluminium.—(M. Fahlberg.)—Aluminium dissolves in an anhydrous mixture of methylene iodide and ether, the chief reaction being expressed by the equation $3\text{CH}_2\text{I}_2 + 4\text{Al} = 3\text{C}_2\text{H}_4 + 4\text{AlI}_3$. Aluminium added to equal volumes of anhydrous ether and methylene iodide containing a little iodine, and the mixture is gently heated. Some of the ether distils over, the liquid becomes cloudy and then colourless and limpid again. Anhydrous ether is then added to prevent the mixture becoming too hot. When the temperature is high or the concentration of the methylene iodide is increased, a secondary reaction takes place, which gives rise to the formation of ethylene, and can probably be expressed by the equation $6\text{CH}_2\text{I}_2 + 4\text{Al} = 3\text{C}_2\text{H}_4 + 4\text{AlI}_3$. Both these reactions occur with methylene bromide, but the second is less important. In this case the solution forms two layers which might be supposed to be the aluminium haloid of the organo metallic substance. Aluminium bromide gives the compound $\text{AlBr}_3 \cdot \text{C}_4\text{H}_8\text{O}$ with ether, but it is very soluble in ether, and its formation could not account for the existence of the two layers. The lower layer cannot be distilled without undergoing decomposition, and it may be supposed to contain haloid combined with

ether. The upper layer, when concentrated again, gives two layers, of which the lower is identical with the preceding, while the upper consists of a liquid which is decomposed by heat. It reacts energetically with water, with liberation of methane in amounts which are proportional to the weight of aluminium used. An aqueous solution is left which contains the halogen salt of the aluminium and alumina; the supernatant ether contains only a small quantity of methylene bromide. Absolute alcohol reacts with the same energy as water, and so also do substances possessing hydroxyl groups, methane being formed. Neither ammonia nor aniline causes the liberation of gas. The organo metallic derivative, according to the formula given, should contain a double bond, and give addition products. This is found to be the case, two atoms of iodine being fixed per atom of aluminium used. When the product is treated with water, no gas is evolved. If the ether is distilled off, and the distillate is shaken with a solution of silver nitrate, an abundant precipitate of silver iodide is formed. The same distillate, after being dried over sodium and treated with magnesium, gives Griquard's reaction. The reactions are:— $\text{CH}_3\text{I} \cdot \text{AlBr} \cdot \text{I}_2 = \text{CH}_2\text{I} \cdot \text{AlBrI}$.

$\text{CH}_2\text{I} \cdot \text{AlBrI} + \text{H}_2\text{O} = \text{CH}_3\text{I} + \text{AlBrI}(\text{OH})$.
(*Comptes Rendus*, CLXXIV., 1922, 112.)

PROCEEDINGS OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING January 26, 1922.

SIR CHARLES SHERRINGTON, *President*, in the Chair.

The following Papers were read, the Summaries here printed having been supplied by the Authors for use at the Meeting:—

PROF. W. A. BONE, D.Sc., F.R.S., A. R. PEARSON, M.Sc., LL.B., E. SINKINSON, B.Sc., D.I.C., and W. E. STOCKINGS, M.Sc. Researches on the Chemistry of Coal. Part II.—The Pesinic Constituents and Coking Propensities of Coals.

In the experimental portion of the paper, which comprises the results of a systematic study of eight coals, specially selected for the purpose, it is shown that prolonged extraction of the same by typical resin-

solvents in a Soxhlet apparatus has no appreciable effect upon their coking propensities, which therefore cannot be ascribed to the presence of free resins.

A new method is described for isolation and purification of resins contained in coals; and one so isolated from two typical bituminous coals during the investigation is shown to have a molecular weight of about 450, a composition agreeing well with the empirical formula $C_{31}H_{32}O_3$, and properties corresponding with those of a resene in Tschirch's classification of resins. The amount of such pure resene so isolated in each case did not, however, much exceed 1 per cent. of the weight of coal taken.

It is also shown that the usual pyridine-chloroform method of extracting coal does not, as Clark and Wheeler have claimed, effect "a complete, or nearly complete, separation between the resinous constituents and the degradation products of the cellulose of which coal is conglomerated," but, on the contrary, yields an admixture of resins with a predominance of non-resinous substances, which latter are chiefly of cellulosic origin, and are provisionally designated "humic" bodies in the paper. These are, for the most part, insoluble in ethyl-ether (though soluble in chloroform), and may amount to as much as 4 per cent., or more, of the coal substance in the case of strong coking coals.

It is concluded that the coking propensities of such coals are principally due to the presence, or the formation in them by heat, of such non-resinous "humic" substances of cellulosic origin, *whose fusion temperatures are below those at which they undergo rapid decomposition*; although the still more complex substances of cellulosic origin, which form the main portion of the coal substance and decompose without fusion, have little or no influence upon the coking properties.

J. A. CROWTHER, D.Sc., and B. J. SCHONLAND, B.Sc. On the Scattering of β -rays. Communicated by Sir E. Rutherford, F.R.S.

The scattering of a homogeneous beam of β -rays has been measured for various elements, and at various angles with the beam. The results obtained are compared with the nuclear theory of scattering given by Sir Ernest Rutherford, a correction being applied to the theory to allow for the variation of the mass of the β -particle with velocity.

The results show that the scattering observed is due to single encounters between the β -particle and the deflecting particles as postulated by the theory until the thickness of the scattering material is sufficient to reduce the radiation through a given stop to half value.

The scattering by gold is shown to be in numerical agreement with the corrected theory when measured at very small angles with the primary beam. It increases rapidly as the angle is increased, and finally attains a value which is approximately four times that given by the theory. This high value of the scattering is given by the lighter elements at all the angles investigated.

The present theories of scattering would appear to require some modification when the collisions between the β -particle and the deflecting nucleus are closer than a certain critical distance which is of the order of 10 cm. in the case of gold.

ANN CATHERINE DAVIES M.Sc. The Minimum Electron Energies, associated with the Excitation of the Spectra of Helium. Communicated by Sir E. Rutherford, F.R.S.

The conditions of excitation and maintenance of the orthohelium and parhelium series lines, of the enhanced line λ 4686, and of the helium band spectrum have been investigated in detail. The results of the investigation are considered in the light of recent experimental work on the critical potential differences for the production of radiation and of ionisation in helium, and in the light of recent developments in the theory of the possible stationary states of the helium atom, a discussion of which is given in the *Introduction*.

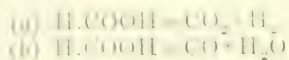
The experiments lead to the conclusion that the lines of the orthohelium and parhelium series are excited only when ionisation of the helium atom has occurred, and that they are all excited simultaneously. The limiting voltages for their excitation are 20.4 and 25.2, according to whether ionisation by multiple impacts can occur or not. The corresponding voltages in the case of the enhanced line 4686 are 54.2 and 80.0 respectively. Evidence was obtained, however, that this line can be excited from the helium positive ion without further ionisation of the atom, at 50.8 volts, the value deduced from Bohr's theory. The minimum

voltage for the appearance of the helium band spectrum is 20.4, and the conditions under which this spectrum appeared support the view that it is emitted by He_2 molecules, for the formation of which electrical excitation of the constituent atoms is essential.

The methohelium and parhelium lines and the band spectrum were maintained as the voltage was backed down to about 13 volts at high pressures. An interpretation of this, on the basis of Bohr's theory, is given, and it is deduced that the extreme ultra-violet lines of the helium spectrum should be absent when the discharge is maintained below 20.4 volts.

C. S. HARRIS-WOOD, H. HARTLEY, and B. TOLLEY. The Influence of Temperature on Two Alternative Modes of Decomposition of Formic Acid. Communicated by Prof. J. W. Nicholson, F.R.S.

Formic acid vapour in contact with glass surfaces between 200° and 300° C. decomposes mainly in the following ways:—



The velocities of these simultaneous modes of decomposition have been investigated with a view to throwing further light on the mechanism of heterogeneous catalysis, and especially on the problem as to whether every molecule with the necessary critical internal energy reacts at once, or whether, in addition to possessing this, the molecule must be in a certain phase. Investigations have hitherto failed to give an unequivocal answer to this question, but the study of the influence of temperature on two simultaneous modes of decomposition of a molecule appeared to offer an opportunity of deciding it.

We find that although the two alternative modes of decomposition of formic acid proceed at approximately equal rates, nevertheless the critical energies calculated from the temperature coefficients of the respective velocity constants are so different that one reaction should predominate almost entirely unless a phase restriction is introduced, and we suggest a possible interpretation of the phase factor in this specific instance.

G. V. REAN, D.S.C. On the Molecular Scattering of Light in Water and the Colour of the Sea. Communicated by Dr. G. T. Walker, F.R.S.

CORNELL UNIVERSITY.

The *Cornell Chemist* for November, 1921, contains a description of the new laboratory of chemistry at the Cornell University. A very extensive building is proposed, with a floor space of some 216,000 square feet. The building will have five floors and large research laboratories are to be provided for each branch of chemistry. It is expected that the building will be completed in the summer of 1923. The journal gives a full account of the laying of the foundation stone, and of the speeches that were delivered on the occasion. The ceremony is said to have been attended by eminent scholars from all corners of the earth.

Mr. George Fisher Baker has made a gift of 1,500,000 dollars for the erection of the chemical laboratory, and personally laid the foundation stone of the building.

Addresses were given by Dr. Edward Leamington Nichols, Professor Edgar Fahs Smith (of the American Chemical Society), Mr. Charles M. Schwab (of the Board of Trustees of Cornell University), and Professor Louis Monroe Dennis (of the department of chemistry).

Mr. Schwab's address was of a highly humorous character, and if space would have permitted we should have been pleased to reproduce it. There is one incident given which applies to England. Mr. Schwab was discussing robes and distinctions generally, and recounted that a short time ago, when in England, he met a man who wore many evidences of distinction, a number of medals and decorations, and he said, "Now that is a man whom I must know." Mr. Schwab went up to him and introduced himself, and asked him if he would tell him why he had so many medals of distinction. He said he would do so with pleasure. He said, "This first large medal you see on my breast I received by mistake, and I got all the others because I had the first one."

In the foundation stone that was laid by Mr. Baker, a copper box was deposited, containing the names of those gentlemen who were associated with the designing and construction of the building, and a great many other items of interest and importance.

If the proposed program is carried out, the Cornell University will undoubtedly have a magnificent laboratory, and cannot fail to do good work in chemical science.

LEEDS UNIVERSITY.

The report of the Advisory Committee on the Departments of Textile Industries, Colour Chemistry and Dyeing and Art, is just to hand. The Committee has received a generous additional grant from the Cloth-workers' Co. to assist in the maintenance of their departments through the year 1921-22. And a resolution was passed, expressing the gratitude of the Committee for the generous decision to increase by £1,000 their grant for the session. The money in question will greatly lessen the difficulties of the present financial condition of the departments. The value of the new laboratory in the colour chemistry department has already been proved, and the work is under the direction of Professor A. G. Perkin, F.R.S., with Dr. Forster, late of the British Dyestuffs Corporation, as lecturer, and Mr. W. G. Sewell as assistant lecturer.

The department has a large scale dye-house for the use of advanced students. A great deal of research work is carried out by the students of the university, and the attendance in all the departments appears to be encouraging.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

The Annual General Meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, February 1st, when the President, Mr. Alfred Smetham, delivered his annual address.

The following were elected as Officers and Council for the ensuing year:—

OFFICERS AND COUNCIL FOR 1922.

Nominated by the Council.

PRESIDENT: P. A. Ellis Richards.

PAST-PRESIDENTS SERVING ON THE COUNCIL (Limited by the Society's Articles of Association to 8 in number): Leonard Archbutt, A. Chaston Chapman, Bernard Dyer, Otto Helmer, Samuel Rideal, Alfred Smetham, E. W. Voelcker, J. Augustus Voelcker.

VICE-PRESIDENTS: F. W. F. Arnaud, C. A. Keme, G. W. Morier Williams.

HON. TREASURER: Edward Hinks.

HON. SECRETARY: E. Richards Bolton.

ASSIST. HON. SEC.: R. G. Pelly.

OTHER MEMBERS OF THE COUNCIL: S. F. Burford, B. A. Burrell, R. L. Collett, C. H. Cribb, B. S. Evans, Norman Evers, Harry Heap, J. H. B. Jenkins, Andrew More, Raymond Ross, W. R. Schoeller, C. J. H. Stock.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

Ordinary Meeting, 1st February, 1922, held at the Chemical Society's Rooms, Burlington House, Mr. P. A. Ellis Richards, President, in the Chair.

The following paper was read: "The Quantitative Separation of Nitrobody Mixtures from Nitro-glycerine," by William Dickson, F.I.C., and W. C. Easterbrook.

"The Quantitative Separation of Nitrobody Mixtures from Nitro-glycerine," by WILLIAM DICKSON, F.I.C., and W. C. EASTERBROOK.

In the process of explosive analysis it is frequently necessary to separate nitrobody mixtures from nitro-glycerine, as these substances are taken out together in the ether extract.

The authors have worked out a method of determining nitrobody in presence of nitro-glycerine depending upon the destruction of nitroglycerine with either ferrous chloride or ferrous sulphate in the presence of methyl alcohol to inhibit a further nitration of the nitrobody. The nitrobody is then recovered by extraction with ether and weighed. The reaction is conducted in the cold to prevent loss of nitrobody by volatilisation. Details of procedure are given by the authors.

THE FARADAY SOCIETY.

ORDINARY MEETING, MONDAY,
FEBRUARY 13th, AT 8 p.m.

At the Chemical Society, Burlington House, Piccadilly, W.1.

Papers to be read:—

Prof. J. R. Partington, D.Sc., "The Energy of Gaseous Molecules."

Ulick R. Evans, M.A., "Passivity and Over Potential."

Prof. A. W. Porter, F.R.S., President, "Note on the Vapour Pressure on Ternary Mixtures."

Contributions to the discussions are invited from Members unable to attend the meeting.

A limited number of Advance Proofs of the above papers will be available before the meeting; applications for these to be made to the Secretary. Non-members are asked to enclose 1s. 3d. to cover cost.

The succeeding meeting of the Society will be held on Thursday, March 9th, at 8 p.m., jointly with the Oil and Colour Chemists' Association. A group of papers will be presented for discussion dealing with the properties of powders considered from different standpoints.

The following letter has been issued by the Chemical Society:—

Hartington House, W.I.

Dear Sir or Madam,—For some time past the Councils of the Chemical Society and of the Society of Chemical Industry have had under consideration a scheme of co-operation in connexion with the reading of papers on pure chemistry before the provincial Local Sections of the Society of Chemical Industry, and the scheme has now been approved by both Councils.

Briefly, the arrangement is that the Committees of the provincial Local Sections of the Society of Chemical Industry in Great Britain will give Fellows of the Chemical Society reading in their district the opportunity of reading papers on pure chemistry and of attending the meetings at which such papers are read.

Such papers, if intended for publication in the *Journal of the Chemical Society*, should be submitted by the author. The papers, after presentation to the Local Sections, will be forwarded to us by the Society of Chemical Industry, and will be considered for publication as if they had been communicated to the Chemical Society direct. The additional costs involved in carrying out this scheme will be borne by the Chemical Society.

The Council feels that many Fellows, who may find it impossible, for one reason or another, to come up to London to present their communications, may welcome the opportunity, where it does not exist already, of reading their papers before an audience of their fellow-chemists and having a discussion on the problems raised. The degree of success achieved by this scheme will depend mainly on local energy and collaboration, and the Council trusts that these will not be lacking. It is felt that anything which makes for closer co-operation between the two Societies is to be welcomed, and we hope you will do what you can in this direction.

The Secretaries of the provincial Local Sections of the Society of Chemical Industry are being supplied with lists of the Fellows of the Chemical Society in the respective districts, and if you reside outside the London area, but within reasonable distance of any such local centre, you should in due course hear further of this matter.

We are,

Yours faithfully,

JAMES C. PHILLIPS,

IRVINE MASSON,

January 27th, 1922.

Secretaries.

FOR THE COMING SOCIETY MEETINGS.

ROYAL SOCIETY.

LIST OF PROBABLE PAPERS FOR READING ON FEBRUARY 16, 1922.

Prof. L. Hill, F.R.S., D. H. Ash, and J. A. Campbell—On the Heating and Cooling of the Body by local Application of Heat and Cold.

Prof. J. B. Cohen, F.R.S., C. H. Browning, R. Gaunt, and R. Gulbrausen—Relationships between anti-septic Action and chemical Constitution, with special reference to Compounds of the Pyridine, Quinoline, Acridine and Phenazene Series.

D. T. Harris—Active Hyperæmia. Communicated by Prof. W. M. Bayliss, F.R.S.

B. B. Sarkar—The Depressor Nerve of the Rabbit. Communicated by Sir E. Sharpey Schafer F.R.S.

Prof. A. Lipschütz, M.D., B. Ottow, M.D., C. Wagner, and F. Bormann—On the Hypertrophy of the Interstitial Cells in the Testicle of the Guinea Pig under different experimental conditions. Communicated by Dr. F. H. A. Marshall, F.R.S.

ROYAL INSTITUTION.

A General Meeting of the Members of the Royal Institution was held on the 6th inst., Sir James Crichton-Browne, Vice-President and Treasurer, in the chair. The deaths of Lord Halsbury, a Member, and of Professor Ciamician, an Honorary Member, were reported to the Meeting, and Resolutions of Condolence passed. Mrs. Wilfred Harris, Lady Hope, Miss A. Shenstone, Miss C. H. White and Mr. J. H. Woodward were elected Members.

On Saturday, February 18, Professor Ernest Gardner delivers the first of two Lectures on "Masterpieces of Greek Sculpture." The Friday Evening Discourse on February 17 will be delivered by Professor D. S. M. Watson, on "The History of the Mammalian Ear."

THE INSTITUTION OF ELECTRICAL ENGINEERS, SAVOY PLACE, VICTORIA EMBANKMENT, W.C.2.

Ordinary Meeting, in the Lecture Theatre of the Institution, Savoy Place, Victoria Embankment, W.C.2, on Thursday, 16th February, 1922, at 6 p.m. (Light refreshments at 5.30 p.m.). "Rotary Converters, with special reference to Railway Electrification," by F. P. Whitaker, Member.

NOTE ON THE MODIFICATION OF DUANE'S APPARATUS FOR PURIFICA- TION OF RADIUM EMANATION.

In 1915, Professor Duane¹ published a method for the purification of radium as collected from aqueous solution, without the use of liquid air. Collection was effected by mercury displacement by means of a system of glass bulbs which acted as an internal pump. In order to remove oxygen and hydrogen from the gaseous mixture, the gases were passed over an electrically heated, partially oxidized copper wire. The glowing wire causes the hydrogen and oxygen to unite, and the excess of hydrogen is reduced by the copper oxide. The water-vapor formed is removed by a side tube containing P_2O_5 . The disadvantage in using an oxidized copper wire as the heating body is twofold. On account of the low resistance of copper, a rather high current, 10 to 15 amperes, must be used initially. As the gas pressure diminishes, the current must be correspondingly diminished in order to avoid overheating of the copper wire.

The modification in the furnace consisted in utilising a platinum wire instead of copper. This has a double advantage in the high melting-point of platinum, and its high resistance. About 5 feet of No. 32 wire was wound on a small rod of silica 5 mm. in diameter and 15 cm. long. This was then incased in a thin tube of transparent silica fitting snugly over the spiral coil. It was found that sufficient heat was conducted through the quartz tube to raise an oxidized copper ribbon, wrapped spirally outside of the quartz tube, to a sufficient temperature to cause hydrogen to be reduced. By this indirect heating of oxidized copper the temperature was controlled so that there was no danger of overheating the copper, and a very low current, 1 to 3 amperes, was sufficient. Such a furnace was satisfactory for a period of nearly a year without renewal. The copper had to be reoxidized from time to time, as in the original Duane apparatus.

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

LECTURES BEFORE EASTER, 1922. FRIDAY EVENING DISCOURSES

addressed to members and their friends at
9 p.m.

February 10.—W. D. Halliburton, M.D., LL.D., F.R.S., Prof. of Physiology, King's College, London.—“The Teeth of the Nation.”

February 17.—Dr. S. M. Watson, MSc., Jodrell Prof. of Zoology and Comparative Anatomy, University of London.—“History of the Mammalian Ear.”

February 24.—John Joly, DSc., F.R.S., Prof. of Geology, University of Dublin.—“The Age of the Earth.”

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—“Problems in the Variability of Spectra.”

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—“The Pigments and Mediums of the Old Masters.”

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—“Auxiliary International Languages.”

March 31.—Arthur B. Walkley, B.A., Author of “Drama and Life,” etc.—“Jane Austen.”

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—“Evolution of the Elements.”

January 28.—Dr. C. Macpherson—“The Evolution of Organ Music.”

January 31.—Prof. H. H. Turner—“Variable Stars.”

February 2. — Sir Napier Shaw —
“Droughts and Floods.”

¹ *Physical Review* (2), 5, 311-314, 1915.

ROYAL MICROSCOPICAL SOCIETY.

A Meeting of the Society will be held in the Lecture Hall, 20, Hanover Square, London, W.1, on Wednesday, 15th February, 1922, at 7.30 for 8 p.m., when the following papers will be read:—

Professor H. L. Rhadia, M.Sc., F.Z.S., F.R.M.S.: "Freshwater Ciliate Protozoa of India."

Mr. A. L. Booth, A.I.C. (Messrs. Armstrong, Whitworth & Co., Ltd.): "The Microstructure of Coal from an Industrial Standpoint."

Captain Frank Oppenheimer, I.M.S., M.B., Ch.B., F.R.M.S.: "A Portable Microscope."



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 9, CHANCERY LANE, London, from whom all information relating to Patents, Trade Marks, and Inventions can be obtained gratuitously.

Latest Patent Applications.

1081—Farrington, Vorn Meister, Lucius & Brunning.—Process of preparing arsene compounds. January 12.

1288—Goodwin, C. J.—Manufacture of oxides of nitrogen and nitric acid. January 14.

911—Nagatoki, Chikahito, Co.—Processes of vulcanizing rubber. January 11.

712—Koster, G.—Apparatus for neutralizing sulphuric or ammonia in its wet state. January 10.

702—Seeling, F. H.—Chemical manometer for determining blood pressure. January 10.

Specifications Published This Week.

173,274—Ampel, R.—Azine dyes obtained from coniferous resins and their process of manufacture.

151,984—Thersell, C. T.—Process for the production of ammonia from cyanides during heating in the presence of water.

173,330—Johnson, J. Y.—Manufacture and production of hydrochloric acid.

173,313—Carpmael, W.—Manufacture of new mordants and process of dyeing basic dvestuffs on cotton.

173,337—Naef, E. E.—Manufacture of metals from their sulphides.

156,135—L. Air Liquide Soc. Anon. Pom. l'Etude et l'Exploitation des Procédés, G.—Synthetic production of ammonia.

Abstract Published This Week.

Sulphur, Carbon. Patent No. 172,074.—A process for treating sulphur has been devised by Mr. E. E. Naef, of 16, Loughborough Road, West Bridgford, Nottingham. Sulphuretted hydrogen, either alone or mixed with other gases and with or without the presence of ammonia, is partially oxidized by means of highly active carbon, so as to obtain sulphur. Air or oxygen is supplied when necessary. Ammonium sulphide may be similarly treated in aqueous solution. The deposited sulphur is removed from the carbon by solvents. Suitable carbon for use in the process can also be obtained by carbonization at low temperatures of materials such as wood, coconut and other shells, or finely divided anthracite, activated by air or steam at low temperature. Such carbons as these known under the trade marks Elonite or Norite may be used.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on post free for the official price of 1s. each.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3227.

BRITISH INDUSTRIES FAIR.

SOME FACTS AND FIGURES OF THE EIGHTH FAIR.

With reports current on all sides of improving trade conditions, the greatest interest is being taken in the forthcoming British Industries Fair, the eighth of an unbroken series, which will be held from February 27th to March 10th next. The Fair, which is organised by the Department of Overseas Trade, will again consist of two sections, one for such commodities as engineering stock, hardware, tools at Birmingham, and the other for lighter goods at the White City, London.

The two sections will be held concurrently, and in both cases the exhibits will be displayed under one roof, or rather under one series of roofs, for no one building is large enough to hold a complete section of the Fair.

A quarter of a million invitations to buyers in the United Kingdom are being issued during the next few days by the Department of Overseas Trade, and nearly 50,000 have already been sent to buyers overseas. The Fair has also received considerable publicity overseas, and already a considerable number of overseas buyers have written expressing their interest and intimating their intention to attend.

In many of these replies, overseas buyers have raised questions of interest to themselves and British manufacturers, and as a result orders for British firms have already been secured. A point of interest about the Fair is that it is entirely self-supporting, all costs of construction, maintenance, publicity and so on being borne by exhibitors.

With the exception of textiles, the Fair will represent in its two sections practically every British industry. It is open to Dominion manufacturers to exhibit, but middlemen do not participate.

The fact that all the exhibitors are actual manufacturers is of great value to buyers, especially those from overseas, since it eliminates the confusion and waste of time which is apt to arise when the same goods are shown at different prices and in different parts of the Fair. Other advantages for overseas buyers include the free use of a special club, equipped with reading and

writing rooms, and the free services of interpreters.

Preparations at Castle Bromwich Aerodrome, where the Birmingham Section will be housed, and at the White City, London, are now well advanced, and at both these big buildings the actual exhibits of many firms have already arrived.

Some idea of the size of the Fair can be obtained from the fact that at the White City alone 200 tons of timber and 15 tons of nails have been used in the construction of the exhibitors' stands, which cover 200,000 square feet of actual exhibiting space. These stands, which are being painted to suit the needs of individual exhibitors, have absorbed 20 tons of paints and distempers. Over 10,000 asbestos panels, each weighing half-a-hundredweight, have also been used. The total area of the stand walls amounts to a quarter-of-a-million square feet, the frontage of stands alone being $3\frac{1}{2}$ miles in length. When the stands at Birmingham are added the total distance which a visitor will have to walk to inspect the whole Fair will be well over five miles.

To protect the exhibits, each stand has a muslin ceiling, no less than 12 miles of muslin having been used for this purpose. The counters, which form so prominent a feature of the stands, involve the use of nearly 46 miles of cloth as covering, while floor-coverings amount to 22,500 square yards. In order to ensure adequate light for the whole of these vast preparations, 13 miles of ordinary electric cable and 12 miles of flexible cable have been installed. Through this 25 miles of wire will be conveyed, the current to light 8,000 lamps, each complete with shades and fittings.

These lights are controlled through no fewer than 111 fuse boards, and six miles of straining wire have been used to support this vast mass of electrical material.

In a few days the exhibitors themselves will be busy making the final preparations for the rush of buyers, which will begin on February 27th next.

HOLLAND.

Under the style of "N.V.W.A. Scholtens Chemische Fabrieken," three manufacturers of Groningen have founded, in this town, assisted by German manufacturers, a company with a capital of 240,000 florins, for manufacture of chemicals and trade with England, Belgium, Spain, France, Italy, Luxembourg and Portugal. (*Chem. Zeit.*, 1921; p. 319.)

Ind. Chimique, Dilo. 1921.

Contribution from the Department of
Chemistry, Cornell University.
GERMANIUM TETRA-GERMANIUM
TETRABROMIDE AND GERMANIUM
TETRACHLORIDE.¹

By L. M. DIXON and F. E. HANCL.

(Continued from last week, February
10th, Page 69.)

B. GERMANIUM TETRACHLORIDE

Germanium tetrachloride was first prepared by Clemens Winkler in 1886. He found its specific gravity to be 1.887 at 18°, its boiling point 80°C., and he adds that it did not solidify at -28°C. In our investigation upon the compounds of germanium with the halogens it seemed desirable to re-determine the above constants of germanium tetrachloride and to study somewhat further the properties of the compound.

Preparation of Germanium Tetrachloride.

In the preparation of germanium tetrabromide by the action of bromine upon germanium that had been prepared by the reduction of germanium dioxide in hydrogen, the very considerable residue of germanium dioxide that remained after action between the metal and bromine had ceased, showed that reduction of germanium dioxide by hydrogen is difficult to carry to completion when fairly large quantities of the oxide are employed. In the preparation of germanium tetrachloride, a large yield was obtained by employing crystalline, fused germanium² that had been pulverised and thoroughly freed from any adhering flux.

The metallic germanium was heated in a current of chlorine in an apparatus quite similar to that used for the preparation of germanium tetrabromide, except that the lower boiling point of the tetrachloride rendered necessary a modification of the condensing tube. This was given the shape of a U-tube, to the bend of which there was fused a short tube that terminated in a bulb about 60cc. capacity. The condensed germanium tetrachloride flowed down into this bulb and evaporation of the liquid by the nitrogen and chlorine flowing through the apparatus during the run was thus greatly lessened.

About thirty grams of pulverised germanium was placed in boats in the combustion tube. Purified nitrogen was then passed through the apparatus. A freezing

mixture of ice and salt was then packed around the U-tube condenser, the current of nitrogen was turned off, and dry chlorine that had been freed from vapour of sulphuric acid by passage through glass wool was then passed through the apparatus. The temperature of the electric combustion furnace was gradually raised. Reaction between the germanium and chlorine began at about 80°C., and at 180°C. there was rapid combination of the two elements, although the heat of formation of the chloride did not bring the metal to incandescence. When the temperature was raised to 360°C., near the end of the experiment, the metal glowed brilliantly when the chlorine was rapidly passed through the tube.

The germanium tetrachloride was completely condensed in the U-tube. The yield was about 45cc. A very slight reddish-brown residue remained in the porcelain boats. The passage of chlorine was now discontinued, and nitrogen was run through the apparatus while it cooled.

It was found impracticable to free the germanium tetrachloride from chlorine by fractional distillation. Five fractionations gave a final product that still contained some free chlorine. The chlorine was removed by placing the tetrachloride in a distilling flask that had a long neck that was constricted at its lower end and was provided with a side-arm close to its upper end. A cork in the neck carried a glass tube that reached downward into the liquid. The space between this tube and the wall of the neck of the flask was tightly packed with glass wool. The neck of the flask was cooled by a refrigerant on the outside to prevent volatilisation of germanium tetrachloride. The side-arm of the flask was joined to a condenser, and this connected to a U-tube that was packed in a freezing mixture. Upon passing dry air through the liquid at room temperature for seven hours, it was found that the germanium tetrachloride had been freed from chlorine and that only a very small amount of the tetrachloride had been carried over through the condenser.

The residual germanium tetrachloride was then fractionally distilled from the flask. The bulk of the product passed over between 85.2°C. and 85.8°C., and a large middle fraction was obtained that showed a constant boiling point of 85.6°C. The corrected boiling point of germanium tetrachloride is 86.5°C.

¹ J. prakt. Chem., 142 (New Series, 34) 177, 1886.

² The manner of its preparation will be described in a later article.

Analysis of Germanium Tetrachloride.

Known amounts of the substance were sealed off in glass capsules. A capsule was broken under absolute alcohol, the solution was diluted with alcohol to 100cc., and separate portions of this solution were used for the determination of chlorine by precipitation with silver nitrate, and for that of germanium with hydrogen sulphide.

Weight of Ge.

Wt. of GeCl_4 .	Found	Calc.
0.04289 G	0.0144 G	0.0145 G
0.04289 G	0.0145 G	0.0145 G
0.1972 G		
0.1970 G		

Weight of Cl.

Found.	Calc.
0.1301 G	0.1304 G
0.1303 G	0.1303 G

The analysis identifies the substance as germanium tetrachloride.

The Melting Point of Germanium Tetrachloride.

A preliminary determination with a pentane thermometer gave -49°C . as the melting point of the compound. The constant was then accurately determined under the direction and with the assistance of Professor C. C. Bidwell, of the Department of Physics, and we take pleasure in here expressing our appreciation of his kindly co-operation.

The determinations were made with a gold resistance thermometer, the resistance being measured by the fall of potential method. The instrument was calibrated against the boiling points of sulphur and water, the ice point, and the freezing point of mercury.

A test-tube was filled with pure germanium tetrachloride to a depth of 8cm., which sufficed to completely immerse the thermometer. A larger test-tube was brought up around the smaller one to protect the latter from direct contact with the refrigerating agent, liquid air, and to avoid unduly rapid rise of temperature of the frozen samples after the liquid air was removed.

The melting point of germanium tetrachloride was found to be $-49.5-2$.

The Index of Refraction of Germanium Tetrachloride.

The measurement was made with an Abbé refractometer, and the index of refraction at 27°C . was found to be 1.3606.

The Specific Gravity of Germanium Tetrachloride.

A pycnometer of 25cc. capacity was thoroughly dried and was filled with germanium tetrachloride in a dry atmosphere.

25°C .

Specific gravity, GeCl_4 $^{25} = 1.874$.

Chemical Properties of Germanium Tetrachloride.

Germanium tetrachloride is a colourless, mobile liquid that fumes strongly when brought into contact with the air. Our observations of the behaviour of germanium tetrachloride when brought into contact with water, are substantially identical with those of Winkler.¹ Of peculiar interest is the crackling sound that is emitted when the two substances interact. If the container is not shaken, this snapping persists for hours, and can be heard at a distance of six feet.

When germanium tetrachloride is dropped into concentrated sulphuric acid of room temperature, it sinks to the bottom of the tube and is not attacked by the acid even on long standing.¹

Germanium tetrachloride reacts violently with a 1:4 solution of potassium hydroxide, the heat of reaction causing the distillation of some of the tetrachloride before interaction is complete. The germanium dioxide that forms and dissolves in the excess of the reagent is precipitable by carbon dioxide.

When germanium tetrachloride is dropped into concentrated nitric acid, it sinks to the bottom and slow reduction of the acid takes place at the surface of contact between the two liquids. The tetrachloride becomes yellow in colour, but remains clear. Vigorous agitation somewhat hastens the reaction, but does not cause immediate decomposition of the tetrachloride. If the container is not shaken, a considerable portion of the tetrachloride still remains unattacked after 48 hours. Upon dilution of the acid with half its volume of water, however, a slow but steady decomposition of the tetrachloride ensues.

When ammonia is passed into germanium tetrachloride, much heat is evolved and a white precipitate is formed. This substance is now being subjected to further study.

Germanium tetrachloride is soluble in absolute alcohol, carbon bisulphide, carbon tetrachloride, benzene, chloroform, and ether. It dissolves in acetone with the formation of a light, orange-coloured liquid.

Summary.

This article deals with the preparation and purification of germanium tetrabromide and germanium tetrachloride, analyses of the

¹ Loc. cit.

¹ See also H. Friedrich, *Monatsh. f. chemie*, 14, 505 (1893).

two substances, determination of the boiling point, melting point, index of refraction, specific gravity, and some of the chemical properties of the two compounds, and the crystal form and electrical conductivity of germanium tetrabromide.

Ithaca, N.Y.

FRIEND'S THEORY OF VALENCY.

By J. A. MARR SMITH, B.Sc.

A further contribution by J. A. N. Friend to the abundant literature of the theory of valency has recently been published under the title of "Electrochemical Conceptions of Valency," *Journal of the Chemical Society*, 1921, 119, 1040. The author partly recapitulates and, in the light of recent physical and chemical advances, partly amends and refines the theory propounded by him in 1908. The present paper, however, commands attention chiefly in its relation to Werner's co-ordination theory.

Friend claims that Sir J. J. Thomson's physical theory of valency, of which a complete account has recently been published (*Phil. Mag.*, 1921 (vi.), 41, 510), offers

interesting physical interpretations of the essential features of the purely chemical theory of valency suggested by the present author (1908). From the purely electrical standpoint, Thomson distinguishes two kinds of valency—(i.) "*non-ionised valency*" in the union of two atoms without interchange of electrons; the resulting compound conforming to Maxwell's law connecting specific inductive capacity and refractive index, and (ii.) "*ionised valency*" in the union of two atoms, one of which has surrendered one electron or more to the other, the resulting compound not conforming to Maxwell's law. Friend identifies (i.) with the *non-polar valency* of Bray and Branch, the *immobile valency* of Lewis, and the *residual (or latent) valency* of his own theory, and (ii.) with the *polar valency* of Bray and Branch, the *mobile valency* of Lewis, and the *free valency* of his own theory.

Thomson's physical concept is thus bodily translated into a chemical concept, despite that, in the former, ionisation relates solely to electron exchange, whereas in the latter ionisation relates to the dissociation of compounds in solution into ions, entities with *apparent existence*. Many compounds of which the atoms have interchanged electrons and therefore belong to Thomson's "*ionised*" category and Friend's *free valency* category, are in fact non-ionisable

in the chemical sense, and therefore belong to Thomson's "*non-ionised*" category and Friend's residual valency category. Many such compounds combine additively with other compounds to form new compounds which may or may not be ionisable in the chemical sense, and the additional valences are frequently neither in pairs nor yet of equal and opposite sign as required by Friend's theory. Ammonia, a non-ionising compound, combines with non-ionised boron trichloride or boron trimethyl to form a non-ionisable compound, whereas, with hydrochloric acid, it forms a compound giving two ions in solution. In the first case, ammonia, in Friend's theory, must contain nitrogen having residual valency identical with Thomson's "*non-ionised*" valency, whereas in the second case the residual valency of the nitrogen atom is half non-ionised in the NH_4 ion, and half ionised in the Cl ion. The fact is that residual valences are chemically sometimes wholly non-ionised, and at other times partly ionised; residual valency cannot, therefore, be identical with "*non-ionised*," non-polar or immobile valency, nor can free valency be identical with "*ionised*," polar, or mobile valency. The Cl ion of Ammonium chloride is definitely ionised, polar, or mobile, and cannot be simultaneously non-ionised, non-polar, or immobile, though it is definitely equivalent to one-half the residual valency of nitrogen. The evidence gathered in support of Werner's co-ordination theory has conclusively demonstrated the rule that residual valences in pairs of equal and opposite sign exist only when the principal valences join atoms chemically undissociable into ions, and lends weight to the argument, that in such cases only one valence of a pair is a true residual valence, the other apparent valence being a principal valency of the atom bound by residual valence.

One salient point that emerges from Friend's paper is that neither in his, nor probably any other theory, can chemical ionic dissociation be a criterion of valency. Nevertheless, any theory of valency, not broadly founded on the facts of chemical ionic dissociation, can have but a limited applicability and slight hope of acceptance among chemists. It is rather remarkable that Friend ignores that the phenomena of chemical ionisation have an explicit as well as an implicit explanation in Werner's co-ordination theory, with which he is in partial agreement. The latter theory is consistent with the facts in requiring, in ammonium chloride, three hydrogen atoms to be united to nitrogen by principal

valency, and one hydrogen atom by residual affinity, and all four hydrogen atoms to be non-ionisable, and the principal valence of the fourth hydrogen atom to be united to an ion, the chlorine atom. This follows from the maximum co-ordination number four for nitrogen, and the rule that the maximum number of ions associated with a complex is equal to the principal valency of the atoms bound by residual affinity. Friend, however, states that the co-ordination theory, "breaks down entirely when applied to simple inorganic compounds, such as ammonium chloride, containing only ionised valencies." If this were true, ammonium chloride should give six ions in solution, whereas it gives two, chlorine with one mobile valence, and the ammonium radical with four immobile valences.

Potassium platinichloride is shown in Friend's paper with tervalent chlorine atoms linked together in a plane hexagonal ring. Nevertheless, Friend assumes the chlorine atoms "to lie at the corners of an octahedron." This being so, the chlorine atoms must be quinevalent, not tervalent, for every corner of an octahedron is adjacent to four, not two other corners. Each of the two chlorine atoms, with attached potassium atoms, can be displaced by nitrogen atoms in the form of ammonia, to form a new stable complex. Such nitrogen atoms must be *septavalent* if the octahedral structure remains. A similar argument applies to the cobalt complexes figured graphically as hexagonal rings but elsewhere described as octahedra. Extending Friend's theory to hexammino-cobaltic complexes having very large kationic volume, it is evident that the very large octahedral shell of interlinked ammonia groups could not retain the cobalt atom of very small atomic volume in the interior, unless yet other residual valency forces, to link together nitrogen and cobalt are assumed, some of the nitrogen atoms in consequence being *nonavalent*. As yet septa- or nonavalent nitrogen has no chemical evidence in its favour.

The succinato and cis-isothiocyanato-cobaltic complexes figured as hexagonal rings, though also described as octahedra, appear to have no bearing on Friend's theory that could not much better be shown by the simplest cobaltamines, and are in any event identical, as *octahedra*, with co-ordination structures, so far as the spatial relations of the groups are concerned. It must be remarked, however, that in the

silver nitrate addition compound, the non-ionisable silver atom is almost certainly attached to the sulphur atom, for it is well known that silver, like thallium, has a selective non-ionising affinity for sulphur, and, moreover, Werner has proved that, in the cis-isothiocyanato-complexes, the nitrogen atom is implicated in the co-ordination sphere, i.e., is united to cobalt.

With regard to the carbonato- and chromato-pentamines, referred to as "not capable of direct explanation by Werner's theory," it must be stated that in so far as the carbonato- (or chromato-) group is concerned, Friend's explanation is identical with Werner's, one oxygen valence being bound in the complex and non-ionisable and the other valence non-ionisably bound to the carbon (or chromium) atom, which is non-ionisably bound to another oxygen atom functioning as half a bivalent ion anchored to the complex. It is implicit in the co-ordination theory that only such atoms or groups in a complex as are not co-ordinated with the complex can give their usual analytical reactions, and, so long as a portion of a polyvalent group is bound in the co-ordination sphere, the group, as a whole, is unable to furnish the complete polyvalent ion. Nothing further is indicated by Werner's graphic formula. The essential difference between Werner's and Friend's formulæ, is that Werner does not commit himself on the question of inter-linking of ammonia, evidence being lacking, whereas Friend arbitrarily assigns a hexagonal ring structure of linked nitrogen atoms to a structure described as octahedral.

Friend states that "Werner's theory does not explain the non-ionising character of the complex ion since he himself showed there was no distinction between his *Haupt* and *Neben* valencies." The non-ionisability of the parts of a complex ion is itself some evidence of such lack of distinction; the evidence, however, referred to produced by Werner as to *haupt* and *neben* valency, relates to the effect on polarised light, in which connection no distinction between them could be drawn. The non-existence of the distinction in other directions may yet prove to be an "intelligent anticipation" on the part of Werner.

An explanation of the optical activity of cobalt complexes, based on models constructed in accordance with his shell theory, is promised by Friend, to show that the activity is due to an asymmetric nitrogen atom, not to an asymmetric arrangement

round the cobalt atom. Optically active metallic amplexes, however, are known which do not contain nitrogen, e.g., the examples metallic oxalates. Presumably asymmetric carbon atoms might furnish an explanation, though there seems to be no evidence denying to adult atoms a spatial distribution of chemical forces not denied to carbon, nitrogen, sulphur, tin and other atoms.

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EDGBASTON.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

SULPHOBENZIDE—*Eug. Grandmougin*.—The author's work confirms the view that sulphobenzide can have only a very limited application in the manufacture of synthetic dyes. On oxidation it gives a dinitro derivative which, on reduction with sodium sulphide, yields the corresponding diamido derivative. This can be proved to be the 3-3 compound. It may be regarded as being composed of two molecules of aniline united by the SO_2 group, and it is interesting to notice that the dyes obtained from it do not differ appreciably in shade from those obtained from aniline. As a rule they do not dye cotton, in spite of their symmetrical constitution. The author compared these dyes with those derived from 4-4' diamino sulphobenzide, and found that in the latter the chromophoric influence of the sulpho group was much greater than in the dimeta derivatives, and their affinity for cotton was decidedly greater. Nevertheless, the chromophoric power of 4-4' diamido sulphobenzide is much less than that of 4-4' diamidothioaniline and of benzidine. Thus, while 4-4' diamido sulphobenzide gives with two molecules of acid H (in alkaline solution), a reddish violet on cotton, the corresponding colour given by 4-4' diamidothioaniline is blue violet, and that of benzidine a greenish blue. Only the latter is of technical importance.

OXIDISING PROPERTIES OF THORIUM X—*Pierre Lemaire and Léon Jaloustre*.—When 50 microgrammes of bromide of thorium x are added to a solution of adrenaline, the solution turns first pink and then brown, showing that oxidation occurs. The action is much more energetic than with the chloride and lactate of manganese. Simi-

larly thorium x causes the appearance of a precipitate of oxymorphine in a solution of morphine hydrochloride. On the other hand the primary alcohols of the fatty series are not oxidised to an appreciable extent by thorium x, nor by the bromides of radium, mesothorium, or radiothorium. (*Comptes Rendus*, CLXXIV., 1922, No. 3.)

DETERMINATION OF FATTY ACIDS BY THE FORMATION OF THEIR COMPOUNDS WITH URANYL AND SODIUM—*J. Barlot and M. T. Brenet*.—Streng has already pointed out that the sodium ion can be detected by the formation of an insoluble crystalline double acetate of uranyl and sodium. In order that Streng's reaction may occur it is necessary that H ions should exist in the solution. The formation of this double salt can be used to detect either sodium, uranium or acetic acid, and the authors have now extended it to the homologues of acetic acid. They find that it always gives positive results when the fatty acid contains in its chain an even number of consecutive carbon atoms, as, for example, in the acetate, normal butyrate, ordinary valerianate and normal caproate. As regards the acids derived from acetic acid by the substitution of one of the hydrogen atoms of the CH_3 group, the power of giving double salts depends upon the nature of the radical introduced. The three chloro-acetic acids give no reaction, but the phenyl acetate of sodium in presence of uranyl nitrate gives an immediate precipitate of crystalline needles. The formula of this salt is $\text{C}_6\text{H}_5\text{CH}_2\text{CO}_2\text{Na}$ ($\text{C}_6\text{H}_5 + \text{CH}_2\text{CO}_2$) $_2\text{WO}_2$. (*Comptes Rendus*, CLXXIV., 1922, No. 2.)

CHLOROFORM AND PEPSIC DIGESTION—*A. Astruc and E. Renaud*.—Pure chloroform seems to possess only a very slow destructive influence on diastatic activity, the loss of activity of pepsine being almost negligible even after it has been in contact with the chloroform for four days. Chloroform vapour has no action. Water containing chloroform is a good solvent for pepsine and can very well be associated with it in preparations which have to be absorbed in a few days. Chloroformed water is, however, a bad medium for digestion *in vitro*, and exercises a decided retarding action upon digestion. (*Journal de Pharmacie et de Chimie*, XXV., 1922, No. 3.)

SOLUTION OF NOVOCOCAINE—ADRENALINE FOR LOCAL ANÆSTHESIA—M. Pierre Breteau.—When solutions of novococaine sterilised by heat are used, even considerable injections of the anæsthetic often do not give satisfactory results. Novococaine seems to undergo no alteration from the chemical point of view when it is sterilised, but a decided diminution of anæsthetic activity is observed. Neutral solutions of cocaine also lose their activity after a time. This disadvantage can be remedied by dissolving novococaine (1gr.) and adrenaline solution (100 drops of a one-thousandth solution) in 100gr. of distilled water saturated with benzoic acid. Bulls containing 5cc. of this solution are employed. They need not be sterilised, as the benzoic acid acts as an antiseptic and also preserves all the activity. The activity of the solution is remarkable, and only very small quantities need be employed. (*Journal de Pharmacie et de Chimie*, XXV., 1922, No. 3.)

GENERAL NOTES.

CHEMICAL PROGRESS.

In consequence of the blockade, Russia has given great attention to the question of chemistry in the laboratories of Karpoff, of the Institute of Applied Chemistry; Scientific and Technical Institute; Station for Testing National Patents, &c.

A Special Chemical Department has been instituted in the Superior Board of Economy for new products. A new method has been invented for manufacture of nitric acid and treatment of chromium and its alloys. A study has been made of the employment of sulphur fumes in preparation of copper and apparatus for potassium chlorate. Progress has been made in manufacture of sulphur colours and metaphenylene-diamine; paranitro aniline; naphthylamine and toluidin. The province of Archangel has supplied salicylate; cafein; morphin; codein. Russia also produces magnesia; soda; aluminium; platinum; cellulose; bone meal; artificial camphor; technical muriatic acid and aluminium sulphate without iron. Finally, fuel oil; sun-flower table oils, and soap.

Ind. Chim., January, 1922.

CANCER RESEARCH.

Very useful work seems to have been done by the Imperial Cancer Research Fund, which was founded in 1902, under the patronage of His Majesty, King Edward VI. It works under the direction of the

Royal College of Physicians and the Royal College of Surgeons. The staff acts in close collaboration with various laboratories and hospitals. The President states that the results include:—

1. The recognition of the fact that cancer is not a disease peculiar to civilised man, but occurs in all the races of mankind and in all vertebrate animals, is a direct consequence of our work.

2. Improvements in the form in which the national mortality from cancer is presented in the Registrar-General's reports were introduced in consequence of the statistical investigations carried out by the staff and in collaboration with them.

3. Study of the possibility of the transmission of the disease from one animal to another and its limitations was shown to separate cancer from the known infectious diseases. The danger of association or contact with cancer patients was thus shown to be negligible.

4. The importance of early diagnosis, the local character of cancer at its start, and the possibility of permanent cure by early operation are now the accepted basis of the treatment of cancer, mainly as a result of the experimental demonstration of these facts by our workers.

5. The part played by heredity in cancer was proved by the work done here.

6. In addition to these questions of general interest, severely technical special inquiries have been carried out and the results given to the world in the scientific reports of the Fund.

EDUCATION FOR THE WORKERS.

The recent report of the Welsh District of the Workers' Educational Association for 1921, indicates that numbers of miners, as well as other workmen, are taking advantage of the opportunities afforded by this body for educational advancement.

The value of the movement lies in the fact that it favours no sect or any particular school of political thought. It is a corrective against revolutionist ideals; while at the same time it affords a wider outlook to those imbued with reactionary theories. The whole purpose of the Association is, in fact, to educate the worker in the strictest sense of the term. The range of the syllabus is a wide one, and covers a large number of subjects. There are at present something like 2,500 students undergoing the course in the district.

The Coal Industry, February 9th, 1922.

PROCEEDINGS OF SOCIETIES.

THE ROYAL SOCIETY.

(PROVISIONAL REPORT).

ORDINARY MEETING—February 2, 1922.

SIR CHARLES SHERRINGTON, President, in the Chair.

The following Papers were read, the Summaries here printed having been supplied by the Authors for use at the Meeting:—

C. SHERRER, F.R.S. On the Oxidation Processes of the Echinoderm Egg during Fertilisation.

The oxygen consumption and the carbon-dioxide output of the eggs of the sea-urchin *E. microdepressulatus* during fertilisation has been measured in a definitive quantitative manner, by means of a special form of the Barcroft differential manometer, in which it was possible to bring about the fertilisation of the eggs in the closed chambers of the apparatus. An immediate consumption of oxygen and a corresponding output of carbon-dioxide takes place on the sperm being added to the eggs. At the end of one minute, this increase is equivalent to a rise in the metabolic rate of the egg of more than 8,000 per cent. The study of sections of fixed material preserved during different intervals of the process of fertilisation shows that this initial increase of the oxidation rate of the egg is brought about by the contact of the sperm with the external surface of the egg membrane, and before it has entered the egg and formed a definite male pronucleus. The fusion of the male and female pronucleus in the later phases of fertilisation, is without any influence on the curve of the oxygen consumption in this process. It has been demonstrated that the dipeptide Glutathione is present in both ripe germ cells of the sea-urchin *E. miliaris* in appreciable quantity, but one minute after fertilisation it is found in much greater quantity in the egg in reduced form, and certain evidence is adduced to show that it plays a very important, if not the chief, part in the oxidation processes taking place in the ovum on fertilisation.

J. SCHMIDT. The Breeding Places of the Eel. Communicated by Mr. C. T. Regan, F.R.S.

By a study of the distribution of the larvæ the author demonstrates that the

common or fresh-water eel (*Anguilla anguilla* or *A. vulgaris*) of Europe has only one breeding area, which is situated in the Western Atlantic, south-east of Bermuda. The larvæ are pelagic, and are carried to the east and north-east by the Gulf Stream; their growth and the metamorphosis into the "elver," or young eel, are described, and it is shown that the elvers are three years old. The breeding area of the American eel (*A. chrysopa*) is south-west of that of the European eel, but overlaps it; in the American eel, growth of the larvæ is much more rapid than in the European species, and the elvers are only one year old. This difference in their life-history explains why the European eel is not found in American rivers nor the American eel in Europe; if larvæ of the American eel are carried eastwards, the metamorphosis into the elver, fitted for life on coasts and in rivers, takes place in the middle of the Atlantic; if larvæ of the European eel go north or north-west they reach the American coast two years before the metamorphosis is due.

J. GRAY. The Mechanism of Ciliary Movement. Parts I. and II. Communicated by Prof. J. S. Gardiner, F.R.S.

1. *Mechanism of Ciliary Movement.*—The rate of beat of the cilia on the gills of *Olytilus edulis* can be controlled by adjusting the hydrogen ion concentration of the cell interior. The amplitude of the beat can be controlled by an alteration in the osmotic pressure of the external medium.

The structure of the cilium and the form of the normal beat indicates that the energy expended during the effective stroke is derived by the interior of the cell; the cilium is essentially a bundle of elastic fibres, whose tension varies during the different phases of the beat.

The activity on cilia and that of muscle cells appears to depend on the same conditions and on similar mechanisms.

2. *Effect of Ions on the Cell Membrane.*—The normal properties of the cell membrane are only maintained in the presence of divalent cations. As long as the cell wall remains intact, ciliated cells are not permeable to anions; they are, however, permeable to monovalent cations. Ciliary activity may persist when the normal semi-permeable properties of the cell wall have been destroyed.

J. S. HUXLEY and L. T. HOGBEN. Experiments on Amphibian Metamorphosis and

Pigment Responses in Relation to Internal Secretions. Communicated by Prof. E. W. MacBride, F.R.S.

1. Salamandra and Triton larvæ may be metamorphosed by immersion in a dilute solution of iodine. Metamorphosis is retarded by low temperature. High temperature at first causes increased growth of the gills.

2. Sexually mature Axolotls can be made to undergo metamorphosis by means of a thyroid diet.

3. Metamorphosis is accompanied by exophthalmos, apparently in all Amphibia.

4. In the case of the Axolotl, the time required for metamorphosis induced by enforced air-breathing is considerably longer than when induced by thyroid-feeding.

5. Administration of iodine free of organic combination, or fresh glandular substance of the prostate and pituitary anterior lobe, is without any effect in relation to the metamorphosis of the Axolotl.

6. Thyroid-feeding continued for seven months was not accompanied by any noteworthy somatic changes in Necturus.

7. Pituitary-feeding (posterior lobe or whole gland) produces a marked temporary dilatation, followed later by excessive contraction of the dermal melanophores in albino Axolotls.

8. Adrenal medulla extract produces, temporarily, complete contraction of the dermal melanophores in the Axolotl.

9. Pineal administration rapidly brings about a striking transient contraction of the dermal melanophores in frog tadpoles. It has, however, no effect upon the melanophores of the Axolotl.

THE GEOLOGICAL SOCIETY OF LONDON.

The following interesting lecture was delivered at the February Meeting of the above Society. (Abstract):—

MR. CYRIL EDWARD NOWILL BROMEHEAD, B.A., F.G.S., delivered a lecture on the "Influence of Geology on the History of London."

The 6-inch Geological Survey maps constructed by the Lecturer were exhibited, and some of the new features pointed out. The small streams now 'buried' are indicated on the maps, and the historical research involved in tracing them led to an appreciation of the connexion between the geology and topography on the one hand,

and the original settlement and gradual growth of London on the other. The reasons for the first selection of the site have been dealt with by several writers: below London the wide alluvial marshes formed an impassable obstacle; traffic from the Continent came by the ports of Kent, and, if destined for the north or east of Britain, sought the lowest possible crossing of the Thames. This was near old London Bridge, where the low-level gravel on the south and the Middle Terrace deposits on the north approached close to the river-bank. A settlement was obviously required here, and the northern side was chosen as the higher ground. The gravels provided a dry, healthy soil and an easily accessible water-supply; they crowned twin hills separated by the deep valley of the Walbrook, bounded on the east by the low ground near the Tower and the Lea with its marshes, and on the west by the steep descent to the Fleet; the site was, therefore, easily defensible. The river-face of the hills was naturally more abrupt than it is now, owing to the reclamation of ground from the river; the most ancient embankment lay 60 feet north of the northern side of Thames Street.

The first definite evidence of a permanent settlement was the reference in Tacitus. The early Roman encampment lay east of the Walbrook, and the brickearth on the west around St. Paul's was worked. Later the city expanded until the St. Paul's hill was included, the wall being built in the second half of the 4thth century. The great Roman road from Kent (Watling Street) avoided London, and utilised the next ford upstream—at Westminster—on its way to Verulamium and the north-west. The earliest Westminster was a Roman settlement beside the ford, built on a small island of gravel and sand between two mouths of the Tyburn. This settlement could not grow, as did London, since the area of the island, known to the Saxons as Thorney, was small. The road from London to the west joined the St. Albans road at Hyde Park Corner, running along the 'Strand,' where the gravel came close to the river; a spring thrown out from this gravel by the London Clay was utilised for the Roman Bath in Strand Lane.

Throughout Mediæval times London was practically confined to the walled city, a defensible position being essential. The forests of the London-Clay belt on the north

are indicated in Domesday Book and referred to by several writers, notably Fitzstephen, whose Chronicle also mentions many of the springs and wells and the marsh at Moorfields, produced largely by the damming of the Walbrook by the Wall. The same writer mentions that London and Westminster are 'connected by a suburb.' This was along the 'Strand,' and consisted first of great noblemen's houses facing the river and a row of cottages along the north side of the road; this link grew northwards, at first slowly, but in the second half of the 17th century with great rapidity. By the end of that period the whole of the area covered by the Middle-Terrace Gravel was built over, but the northern margin of the gravel was also that of the town for 100 years, the London-Clay belt remaining unoccupied.

The reason for this arrested development was that the gravel provided the water-supply. In early days the City was dependent on many wells sunk through the gravel, some of which were famous, such as Clerkenwell, Holywell, and St. Clement's. In the same was the outlying hamlets (for instance, Putney, Roehampton, Clapham, Brixton, Ealing, Acton, Paddington, Kensington, Islington, etc.) started on the gravel, but later outgrew it, as pointed out by Prestwich in his Presidential Address of 1873. In the City the supply soon became inadequate, or as Stow says, 'decayed,' and sundry means were adopted to supplement it. The conduit system, bringing water in pipes from distant springs, began in 1236; London-Bridge Waterworks pumped water from the Thames by water-wheels from 1582 to 1817; the New River was constructed in 1613, and is still in use. It was not until the 19th century that steam pumps and iron pipes made it possible for the clay area to be occupied, thus linking together the various hamlets that are now the Metropolitan Boroughs.

Some of the ways in which Geology affects London to-day were briefly indicated, and the lecture was illustrated by a number of lantern-slides, reproduced mainly from old maps and prints.

SIR JOHN CASS TECHNICAL INSTITUTION.

The Annual Prize Distribution at the Sir John Cass Technical Institute was held on Wednesday, February 8th, when the prizes were distributed by Professor William

Rothenstein, Principal of the Royal College of Art.

The Chairman of the Governing Body, the Rev. J. F. Marr, in giving a summary of the work of the Institute during the past session, stated that the increase in the number of students had been more than maintained, and that the capacity of the Institute, especially in the Science Departments, had been taxed to the utmost.

Twenty students had been engaged in research work during the session, and the total number of investigations published from the Institute had now reached 115.

The Department of Petroleum Technology, which was initiated at the commencement of the present session, is one of the Institute's most important developments, and there were already 150 students in attendance. Representatives of the industry have acted as a Consultative Committee to advise the Governors in respect to the courses of study which have been provided, and the chief oil companies of the London area have given generous support towards the equipment and maintenance of the department.

In the course of an address on "Education and Industry," Professor Rothenstein said he regarded every kind of education as something in the nature of a pursuit after truth. Whereas there was much lip-homage to science and art and the crafts by our merchant princes and captains of industry, these employers did not have the same faith in them as their employees. Commercial men in past civilisations, somehow, knew how to ask for the best, but that was not true of our own civilisation. What we required was a standard of commerce which knew how to utilise what was best in the arts and sciences, for he refused to believe that people, in general, did not value that which was good and beautiful in production.

THE INSTITUTE OF METALS.

ANNUAL GENERAL MEETING, LONDON, MARCH
8TH AND 9TH, 1922.

PROGRAMME.

Wednesday, March 8th.

10 a.m.—General Meeting of Members in the Hall of the Institution of Mechanical Engineers.

The Report of the Council on the work of the past year will be presented by the President.

The Honorary Treasurer will present his Report.

The results of the Ballots for the Council for 1922 and for the election of new Members will be declared. The new President will be inducted into the Chair, and will deliver his Inaugural Address.

A selection of Papers will be presented and discussed.

1 p.m.—The Meeting will be adjourned.

2.30 p.m.—The adjourned Meeting will be continued.

A further selection of Papers will be presented and discussed.

4.30 p.m.—The Meeting will be adjourned.

7.30 p.m. for 8 p.m.—The Annual Dinner at the Trocadero Restaurant, Piccadilly Circus, W.1.

Thursday, March 9th.

10 a.m.—General Meeting of Members in the Hall of the Institution of Mechanical Engineers.

A selection of papers will be presented and discussed.

12.30 p.m.—The Meeting will be brought to a conclusion.

3 p.m. to 5 p.m.—Visit to the Royal School of Mines, Prince Consort Road, South Kensington, S.W.7.

PAPERS.

The following Communications are expected to be submitted in the order given:—

Wednesday, March 8th. (Morning Session 10 a.m. to 1 p.m.)—"Notes on the Corrosion and Protection of Condenser Tubes," by G. D. BENGOUGH, M.A., D.Sc. Member (Investigator to the Corrosion Research Committee).

Wednesday, March 8th. (Afternoon Session, 2.30 p.m. to 4.30 p.m.)—"The Internal Mechanism of Cold-Work and Recrystallisation in Cupro-Nickel," by FRANK ADCOCK, M.B.E., B.Sc. Member (Teddington).

"The Effect of Impurities on Recrystallisation and Grain Growth," by the Research Staff of the General Electric Company, London. (Work conducted by MAJOR C. J. SMITHELLS, M.Sc.)

"Further Studies in Season-Cracking and its Prevention. Condenser Tubes," by H. MOORE, O.B.E., Ph.D., F.I.C., Member, and S. BECKINSALE, B.Sc., Member (Woolwich).

Thursday, March 9th. (Morning Session, 10 a.m. to 12.30 p.m.)—"The Rate of Combination of Copper and Phosphorus at Various Temperatures," by Professor C. A. EDWARDS, D.Sc., Member of Council, and A. J. MURPHY (Swansea).

Note on "Some Cases of Failure in 'Aluminium' Alloys," by W. ROSENHAIN, D.Sc., F.R.S., Vice-President (Teddington).

"Some Mechanical Properties of the Nickel-Silvers," by Professor F. C. THOMPSON, D.Met., B.Sc., Member, and EDWIN WHITEHEAD (Manchester).

"A Further Study of the Alloys of Aluminium and Zinc," by D. HANSON, D.Sc., Member, and MARIE L. V. GAYLER, M.Sc., Member (Teddington).

Note on "The Assay of Gold Bullion," by ARTHUR WESTWOOD, Member (Birmingham).

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

LECTURES BEFORE EASTER, 1922. FRIDAY EVENING DISCOURSES

February 24.—John Joly, D.Sc., F.R.S., Prof. of Geology, University of Dublin.—"The Age of the Earth."

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—"Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—"The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—"Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of "Drama and Life," etc.—"Jane Austen."

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—"Evolution of the Elements."

ROYAL INSTITUTION.

Meetings for the Week.

Saturday, Feb. 18, Prof. E. A. Gardner: Masterpieces of Greek Sculpture, 3. Tuesday, Feb. 21, Sir Arthur Keith: Anthropology of the British Empire, 3. Thursday, Feb. 23, Prof. A. G. Perkin: Dyeing, Ancient and Modern, 3. Friday evening, Feb. 24, Prof. John Joly: The Age of the Earth, 9.

THE CHEMICAL SOCIETY.

Burlington House,

Piccadilly,

London, W.1.

ORDINARY SCIENTIFIC MEETING, THURSDAY,
FEBRUARY 16TH, 1922, AT 8 P.M.

The following Papers were read:—

A theoretical derivation of the principle of induced alternate polarities. *A. Lapworth.*An explanation of the property of induced polarity of atoms and an interpretation of the theory of partial valencies on an electronic basis.—*W. O. Keenmark and R. Robinson.*

New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, at 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 1587 Baker, F. E.—Apparatus for testing, etc., colour of small quantities of liquid. Jan. 18.
 1697 British Dyestuffs Corporation, Ltd.—Manufacture of chloro-ethyl esters, and treatment of phenols, alcohols, and amino compounds with them. Jan. 19.
 1388 Carmichael, & Co., Ltd.—Apparatus for manufacture of sulphuric acid. Jan. 17.
 1362 Byrness, C.P.—Separating aldehyde fatty acids. Jan. 16.
 1577 Collingridge, W. F.—Process of treating ores and concentrates to convert them into sulphates. Jan. 18.
 1691 Cumberland Coal, Power & Chemicals, Ltd.—Manufacture of hydrogen or gases rich in hydrogen. Jan. 10.

Specifications Published this Week.

- 173,528—Hunt, S. B.—Process for the production of reactive acid liquor, alcohols, esters, and the like from gaseous hydrocarbons.
 173,540—British Dyestuffs Corporation, Ltd.—Manufacture of phenyl glycine compounds.
 171,644 Asiatic Petroleum Co., Ltd.—Process and apparatus for dehydrating hydrocarbon emulsions and/or distilling hydrocarbon oils or their products of distillation.

Abstract Published this Week.

172,337—An improved apparatus for treating Ammonium Sulphate has been devised by Mr. R. P. Douglas, of 12, Nelson Square, Bolton. The apparatus is for washing, drying, and neutralising ammonium sulphate crystals, and consists essentially of a *vacuum* bucket having a perforated bottom and a suction vessel which, together with a tube depending from the mouth of the vessel forms a trap for the liquor contained therein. Two forms of the apparatus are described. Having been sucked substantially dry by connecting a vent with a suction device, the crystals in the receiver are washed with a small amount of water, and if a neutral salt be desired, they are then washed with ammonia. Alternatively, the crystals may be treated with steam or gaseous ammonia, in which case the receiver is fitted with a lid having an inlet pipe and valve. The filtered liquor, after

leaving the bucket, forms a trap with the tube, and then passes through the outlet to the mother liquor tank or saturator. For convenience in transporting, the bucket is provided with trunnions or fittings enabling it to be carried by an overhead system. The bucket is made of wood or cast iron, or, like the suction-vessel, it may be lined or made entirely of lead, copper, or other acid-resisting material.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free, for the official price of 1s. each.

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the EDITOR.

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MANUFACTURE OF METHYL ALCOHOL.—The owner of British Patent No. 125945, relating to an Improved Manufacture of Methyl Alcohol, is desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the above invention, either by sale of the Patent rights, or by granting Licences to manufacture under royalty.

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CHEMICAL STUDENT, age 18, pass Inter Sc. Exam., seeks situation near London in Chemical Trade or Laboratory.—Write W. P., 42, Dingwall Road, Croydon.

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3228.

THE EDUCATION OF CHEMISTS.

At a meeting of the Liverpool and North Western Section of the Institute of Chemistry, held at the London and North Western Hotel, Liverpool, on Thursday, February 9th, R. C. Moore, Esq., M.A., M.Sc., M.Ed., A.I.C., Inspector of Schools to the Liverpool Education Committee, gave a lecture on "The Education of Chemists."

Owing to the illness of the chairman of the Section, H. J. Evans, Esq., B.Sc., F.I.C., Prof. Roberts, M.Sc., F.I.C., was elected to the chair.

There was a good attendance of members representative of all branches of the profession.

The lecturer dealt with the subject in a broad and interesting way. He very largely omitted details and dealt with fundamentals. Those portions of the chemist's education on which there are differences of opinion were considered at length.

Emphasis was laid on the necessity for a thoroughly good training in the basic facts and themes of the subject, together with the importance of a sound knowledge of Physics, Mathematics and Modern Languages.

The place of specialisation in a chemical education was carefully considered, and the chemical courses of three typical modern Universities, viz., Leeds, Liverpool and Sheffield, were discussed as examples of the different views which are held on this subject.

The extent to which a student should have experience of Research Work during his academic life was discussed, together with the allowance that should be made for this work at his examinations. The very wide differences in opinion and policy held on this subject by various University authorities was considered.

The desirability of chemical students spending short periods in works or commercial laboratories during their training period was mentioned. In this connection the lecturer described the arrangements made by a large iron and steel works, on whose staff he formerly was, for receiving a party of about a dozen University students for a period of a month or two during each long vacation.

The arrangements and conditions for the award of the new National Certificates in Chemistry to students in Technical Schools and Colleges in England and Wales were considered, and the advantages that would be obtained from them explained.

In conclusion, the fact that professional education did not cease with the obtaining of recognised qualifications was considered, and the educational benefits to be derived from keeping up-to-date in professional matters from the regular reading of one or more technical journals, and from the membership of a professional society were discussed.

An interesting and valuable discussion took place after the lecture. Amongst the contributors to the discussion were Dr. Brislee, Mr. Findley, Prof. Heilbron and Mr. Shepherd.

THE REDUCTION OF FERRIC CHLORIDE.

AN UNUSUAL PROCESS.

By A. Pickles M.Sc., Wyggeston School, Leicester.

It is a generally accepted fact that a solution of ferric chloride is not reduced to the ferrous state by molecular hydrogen. If any reduction should occur, it will most likely be due to the presence in it of hydrocarbons due to the impurities in the zinc or the iron which may be used in its generation.

If pieces of copper are added to ferric chloride solution, it will be noticed after some time that reduction has taken place. The more surface the copper may possess the more rapid the reduction, though even if fine gauze is used the reduction is not very considerable. Acidification of the solution with HCl assists the process to some extent.

The rate of reduction is, however, capable of considerable acceleration in the following manner. The ferric chloride solution is placed in a tall and narrow jar, and pieces of the finest copper gauze added. A delivery tube conveying hydrogen is then placed so that all the hydrogen has to pass over the gauze in its passage through the solution, which is best acidified with dilute HCl. The hydrogen is previously scrubbed by passing over pumice and sulphuric acid, and also through potassium permanganate solution. The reduction of the ferric salt is at first remarkably rapid, especially if fine gauze is used. At the same time cuprous

chloride is formed at the expense of the copper.

The following results were made as nearly quantitative as possible:

(1) Reduction using Zn Acid and FeCl_3 together in the usual manner.

Time (mins.)	3	5	7	10	12	15
KMnO_4 (N/10 conc.) per 10 cems.	11.3	17.5	21.3	23.7	24.5	25

Reduction complete.

(2) Reduction using molecular hydrogen. Copper gauze 24 meshes to the inch.

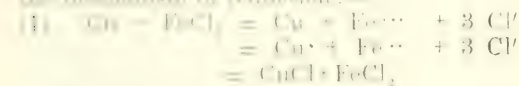
Time (mins.)	1	3	5	7	10	12	15
KMnO_4 conc. 7.5 per 10 cems.	7.3	13	18	20.0	22.1	26	28

(3) Reduction using molecular hydrogen. Copper gauze 80 meshes to the inch.

Time (mins.)	1	3	5	7	10
KMnO_4 conc. 7.5 per 10 cems.	17.3	21	24.9	25	31

The reduction is complete when 10 cems. of the reaction mixture requires 25 cems. of N/10 KMnO_4 for re-oxidation. It will be noticed in runs 2 and 3 that more than 25 cems. are required. This is because some of the cuprous chloride produced goes into solution, and, of course, also decolourises permanganate.

It is at once seen that an increase in copper surface increases the rate of reduction. This suggests some adsorption action. This is certainly part of the action, but the fact that the Fe ions carry three charges, the following equation represents part of the mechanism of reduction:—



The function of the HCl is to take up the cuprous chloride as soon as formed. Of course, the copper, by virtue of its solution pressure, will tend to send into solution some Cu ions, but on the same reasoning so would nickel. With Nickel, however, the reduction is very much slower than with copper. Also, copper is much further removed from iron in the electro-chemical series than nickel, though, of course, the action is not analogous to that of zinc on copper salt solutions.

If platinum gauze is used, reduction again takes place. Now it is well known that platinum will adsorb hydrogen, and since copper gauze is used in the hydrogenation of methyl alcohol to formaldehyde, it is not too much to assume that adsorption takes place in the reaction under consideration.

The forces by which a gas is held to a surface are often very great. They are said to be of the order of 10,000 atmospheres, and under that pressure the surface atoms of the copper gauze are no doubt brought into a condition favourable for reaction. The Ionic Potential of the copper is no doubt exceeded, and the ions thereby liberated will at once unite with any oppositely charged ions which may be in the vicinity. Thus we get the formation of Cu_2Cl_2 .

That Adsorption may really bring about emission of electrons we have only to consider the increased radio-activity of Thorium Sol over Thorium itself. In the sol form the thorium has a well developed surface, and therefore adsorption effects are bound to be present. Similarly, electronic emission is increased by the admission of Hydrogen into an electric arc bulb if the temperature is 1,300 C and the pressure 10^{-6} mm.

This reduction method is not meant to supplant the older method using zinc and acid, because the indeterminate amount of cuprous salt would make accurate work impossible. But it is an experiment of some interest, and still another case of where Adsorption may play an important part.

NOTE.

DANGERS OF CARBON MONOXIDE. — A number of questions were put in the House of Commons on Monday regarding the danger of carbon monoxide in coal gas. Mr. Baldwin, President of the Board of Trade, said that the draft of the special order proposed to be made by the Board of Trade, the effect of which was to prohibit the supply of any gas containing carbon monoxide, unless it had a distinctive pungent smell, had been already approved by a resolution of that House, and the order would be made as soon as the necessary resolution had been passed by the House of Lords. There was no statutory limitation of the proportion of carbon monoxide in gas supplied for domestic purposes. Information was obtained from time to time by the Board of Trade from which it was possible to estimate the proportion of carbon monoxide in the gas. There were very few cases in which it would appear that the proportion would exceed 20 per cent., and, generally speaking, the proportion was considerably below that figure.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

THE RELATIONS BETWEEN CHEMICAL CONSTITUTION AND THERAPEUTIC PROPERTIES: HYPNOTICS—*Paul Putzeys*.—The hypnotic effect of a compound seems to be due to the presence in the molecule of one of the three groups or functions: (i.) The ethyl group C_2H_5 ; (ii.) the group $>C=O$, aldehyde or ketone function; (iii.) an aliphatic ether haloid function. As is to be expected, the saturated hydrocarbons of the fatty series are all hypnotics, and the soporific properties increase from ethane to pentane. The substitution of the ethyl radical by methyl seems to destroy all soporific properties. Propane is more active than ethane, and it seems to be a general rule that the effect produced by an active radical is greater the longer the chain. The substitution in various molecules of one H atom by C_2H_5 gives a series of products which are excellent hypnotics, although sometimes other dangerous or inconvenient effects may be produced. Thus mercaptan $S-C_2H_5$ has

soporific powers, but it is toxic. Its toxicity can be removed by saturating the residual valencies of the sulphur, the product being correspondingly less active. The easiest way to produce this effect is to make mercaptan condense with ordinary acetone, giving a di-thioether, which when oxidised gives the disulphone, sulphonol. It is an excellent hypnotic because it is only slightly soluble, has very little taste, and has usually no effect on the digestive organs. Its action is gradual, and it is not toxic. The cyclic compound barbituric acid, obtained by making an ether of malonic acid react with urea, can be used as the parent substance of a number of hypnotics, of which veronal is the most important. It is obtained when two hydrogen atoms of barbituric acid are replaced by two C_2H_5 groups. It has no effect on the stomach, and is easily and rapidly eliminated, but it has a toxic action. When one C_2H_5 group in it is replaced by C_6H_5 luminal is obtained. It possesses properties like those of veronal, but it is much more active, so that the dose of luminal can be reduced to about one-third of that of veronal. (*Journal de Pharmacie de Belgique*. IV., 1922, No. 6.)

METHODS OF DETERMINING CARBON IN IRON AND STEEL.—*A. Travers*.—The three chief methods of determining carbon in iron and

steel are: (i.) the sulphochromic combustion method, with or without previous separation of the iron; (ii.) the Eggertz method; (iii.) direct combustion of the metal in a current of oxygen. The author has subjected the first of these methods to a systematic investigation, employing Wiborg's process, and has found that unless the gases are finally burnt, the method is inexact and does not give the total carbon, except in the case of slowly cooled steels, when the error is not more than 2 to 3 per cent. Wiborg's method, however, is valuable, inasmuch as it throws some light upon the relations between the chemical constitution of steel and its structure. The method known in France as Carnot and Gontal's method, in which the carbon is separated before the sulphochromic acid is used, is, generally speaking, more accurate than the method of direct attack with the acid. It also enables other elements, such as sulphur or special metals, for example, to be concentrated in the residue. (*Chimie et Industrie*, VII., 1922, No. 1.)

DECOMPOSITION OF NITROUS ACID—*E. Oliveri-Mandala*.—The best way to destroy nitrous acid in presence of nitric acid is to use hydrazoic acid $HNO_2 + HN_3 = H_2O + N_2O + N_2$. A dilute solution of hydrazoic acid or of sodium hydrazoate is added to a solution containing the nitrous and nitric acids, acidified with acetic acid in the case of nitrates and nitrites. The excess of hydrazoic acid must be boiled away, for it would mask the colourations used in the identification of nitrates and nitrites. A portion of the solution must then be tested for the presence of nitrite with an acetic solution of naphthylamine and sulfanilic acid. If it is still present, more hydrazoic acid must be added and the solution again boiled. When all the nitrite has been destroyed nitric acid can be detected by the usual methods. (*Gazz. Chim. Ital.*, LI., 1921, No. 3.)

SEPARATION OF TIN AND ANTIMONY IN HCL SOLUTION BY MEANS OF SULPHURETTED HYDROGEN—*G. Luff*.—The author has found that from solutions containing from 16 to 40 cc. of concentrated hydrochloric acid (Sp. Gr. 1.19) in 100 cc., all the antimony is precipitated on heating while all the tin remains in solution, provided always that the solutions are filtered when cold. The small amount of antimony not precipitated on heating separates on cooling, while the tin remains in solution. Ammonium chloride

acts in the same way as hydrochloric acid, preventing the precipitation of tin. The details of the best procedure to adopt are as follows:—21 cc. of concentrated hydrochloric acid are added to 100 cc. of a neutral solution containing 16.5 gr. of AmCl_3 , and the mixture is heated on a water or a sand bath to 80–85°, a strong current of H_2S being meanwhile passed through the solution. The precipitate of mercury becomes dark red and then black; after half-an-hour the liquid is diluted with its own volume of hot water, and then the temperature is raised to 98–100°, H_2S being passed through for another five minutes. It is then cooled to 30° and filtered through a Gooch filter; thus a colourless filtrate is obtained, which is quite clear and contains no antimony. (*Chem. Rev.*, XLV., 1921, No. 29.)

GENERAL NOTES.

RESEARCH WORK APPARATUS. — Mr. Briant asked the President of the Board of Trade whether any complaints that scientific apparatus essential for research work was difficult to obtain, owing to the operation of the Safeguarding of Industries Act, had reached his Department? Mr. Baldwin replied that no complaints of the kind had been made to his Department, but he understood that certain complaints had been received by the Department of Scientific and Industrial Research, and that their validity was being investigated.

RAT BAIT FACTORY. — Sir A. Griffith-Boscawen, Minister for Agriculture, informed Lieut.-Col. James that in the present need for national economy, and following the recommendation of the Geddes Committee, the Government proposed to close down the Research Laboratory and Rat Bait Factory at the end of the present financial year. The factory was intended to supply bait free of charge for the destruction of rats on Government premises of all kinds. There were no reliable figures as to the amount of damage done annually in this country by rats, but according to unofficial estimates, the annual damage could not be placed at less than £15,000,000.

DUTY ON SANTONINE. — Mr. Mesley asked the President of the Board of Trade whether any decision had been come to by the Board on the question of an appeal

from the decision of the referee on Dec. 10 last, that santonine had been improperly included in the schedule of articles chargeable with duty under Part I. of the Safeguarding of Industries Act? Mr. Baldwin replied: "The judgment in question became effective on 20 Dec. last, when it was signed, and santonine was withdrawn from the lists of dutiable articles as from that date. Notice of its withdrawal was given in the Press."

ZINC CONCENTRATES CONTRACT. — During the debate in the House of Commons last week on the motion for the presentation of an address in reply to the King's Speech, Mr. Wignall, a Labour member, raised the question of the Australian zinc concentrates contract, which was made towards the end of the war between Mr. Hughes, the Premier of Australia, and the British Prime Minister, or someone acting on his behalf. Although the contract served its purpose and was in the interests of the country during the war, for two years now the contract had closed down the British mines.

Mr. Baldwin, President of the Board of Trade, replied that in a week or ten days there would be an estimate on the subject of zinc concentrates, and a full statement would be made then.

ACTION OF LIGHT ON THE HUMAN BODY. — *Committee on Research.* — The Medical Research Council have appointed the following Committee to advise them upon the promotion of researches into the biological actions of light, with a view to obtaining better knowledge of the actions of sunlight and other forms of light upon the human body in health or disease:—

Professor W. M. Bayliss, F.R.S. (chairman), Mr. J. E. Barnard, Dr. H. H. Dale, F.R.S., Captain S. R. Douglas (late I.M.S.), Sir Henry Gauvain, M.D., Dr. Leonard Hill, F.R.S., and Dr. J. H. Sequeira, F.R.C.P. Dr. Edgar Schuster (secretary).

SAMPLING AND ANALYSIS OF COAL COMMITTEE. — The Fuel Research Board of the Department of Scientific and Industrial Research have appointed a Committee to advise upon the sampling and analysis of coal. The personnel of the Committee is as follows:—

Professor Thomas Gray, D.Sc., Ph.D. (chairman), Professor J. W. Cobb, C.B.E., B.Sc., Mr. J. T. Dunn, D.Sc., Mr. J. S. Flett, O.B.E., D.Sc., LL.D., F.R.S., Mr. G. Nevill Huntly, B.Sc., Mr. S. Roy Illingworth, M.Sc., Mr. J. G. King, F.I.C., Mr. C. H. Lander, D.Sc., Mr. R. Lessing, Ph.D., Mr. C. A. Seyler, B.Sc., Mr. F. S. Sinnatt, M.B.E., M.Sc., Professor R. V. Wheeler, D.Sc. Miss T. Renouf, F.C.S. (Secretary).

It is intended that the methods recommended by the Committee shall be adopted in connection with the Physical and Chemical Survey of the National Coal Resources.

Communications for the Committee should be addressed to the Secretary at 16 and 18, Old Queen Street, Westminster, London, S.W.1.

BRITISH CHEMICAL STANDARD STEEL "U" (*Analytically Standardised Sample*).—The latest sample which is now ready for issue comprises a high carbon steel having a little nickel in it as an impurity. It is of special use as

- (1) a standard for carbon by combustion or colour;
- (2) a low manganese standard associated with high carbon;
- (3) a low nickel standard.

The analyses have been undertaken, as usual, by a number of experienced chemists both in the United Kingdom, France and U.S.A. representing the following interests:

British Government Department.

U.S. Bureau of Standards.

Referee Analysts.—Representing users issuing specifications.

Works Analysts.—Representing makers and users.

The standard figures are as follows:—

CARBON STEEL "U."

	%	%
CARBON (combustion)		1.203
„ (colorimetric) approx.	1.18	
Silicon	approx. 0.18	
Sulphur evolved as sulphide		
approx.	0.043	0.472
Phosphorus	approx. 0.055	
MANGANESE		0.472
Copper	approx. 0.05	
NICKEL		0.608
Chromium	approx. 0.03	
Vanadium	trace.	

The standard turnings may be obtained in 500, 100 or 50 gramme bottles, either direct from Organising Headquarters, 3, Wilson Street, Middlesbrough; or through any of

the leading laboratory furnishers at a price just sufficient to cover the cost. A certificate giving the names of the Analysts co-operating, the types of methods used, and a detailed list of the results will be supplied with each bottle.

This sample completes a series of 14 steels containing increments of carbon between 0.03 per cent. and 1.20 per cent., also standardised quantities of the following elements: Si, S, P Mn, As, Ni, Cr, Co, V, W, Ti, and Fe.

The standard may be obtained from the Laboratory and Technical Bureau, 3, Wilson Street, Middlesbrough, England.

THE ROYAL SOCIETY.

ORDINARY MEETING—February 9, 1922.

SIR CHARLES SHERRINGTON, *President*, in the Chair.

The following papers were read, the summaries here printed having been supplied by the Authors for use at the Meeting:—

SIR J. ALFRED EWING, K.C.B., F.R.S.
—*The Atomic Process in Ferromagnetic Induction.*

The object of the paper is to amend the theory of ferromagnetic induction put forward by the author in 1890, and to describe a new model then suggested. In the old model the Weber elements or ultimate magnetic particles were represented by pivoted magnets whose alignment, in the absence of an impressed field, was determined by the forces which they exerted on one another in virtue of their possessing magnetic moment. Consideration of the magnitude of the deflecting force that is required to break up the rows or pairs in which such magnets group themselves has shown that, when the magnets are set near enough together to make their behaviour agree with one known feature of the magnetising process, it fails quantitatively to agree with another known feature. When the range of stable deflection is sufficiently narrow, the stability becomes far too great.

In the new model the idea of magnetic control is retained, with a Weber element in each atom, but the controlling force is supposed to be exerted between the electrons of the atom itself, namely, between the shell, which is held more or less fixed by its relation to neighbouring atoms, and an inner electron system which constitutes the Weber magnet. The control depends on the difference between two nearly equal

appearing forces; this characteristic enables the model to simulate a sufficiently weak current with a narrow range of stable deflection. Models are described whose action reproduces the characteristic ferro-magnetic phenomena. In one model the structure is based on the grouping of electrons suggested by Hall in connection with his X-ray analysis of iron crystals; in another the electron orbits are assumed to have the motion of the atom at their common focus.

Prof. J. W. NICHOLSON, F.R.S.—*Problems Relating to a Thin Plane Annulus.*

The problems which arise in electrostatics and hydrodynamics in regard to the thin annulus cut from a plane sheet of metal are of some importance, more especially in regard to electrical instruments of precision such as the electrometer. Their mathematical solution in an exact form is a matter of extreme difficulty, and only first approximations, which can be derived by simple methods, appear to have been used hitherto. In the present paper, higher approximations are obtained, to an order which appears to be effective for most of the applications which are of real importance. It is shown that the actual difference between the results handling the annulus is of comparatively small significance in such magnitudes as the electrical capacity of the annulus—a result which could not readily be foreseen. The whole investigation is only carried to the second order of significance, but by a method—treating the annulus as a special case of the elliptic anchor ring—which can readily be extended to any desired order. The convergence of such approximate solutions is not discussed, but it is clearly analogous to the remarkable degree of convergence found by Lord Rayleigh in certain solutions of problems of vibration of discs in which eccentricity is taken into account.

Prof. D. H. HAVELOCK, F.R.S.—*The Effect of Shallow Water on Wave Resistance.*

In a previous paper an expression was given for the wave resistance of a surface pressure symmetrical round a point and moving over the surface of deep water. The analysis is now extended so as to include the effect of finite depth of water. The wave resistance is given by a definite integral which is evaluated by numerical and graphical methods, and the results are shown in a

set of curves for the variation of wave resistance with velocity for various ratios of the depth of water to the length associated with the pressure distribution. The cases intermediate between deep water and shallow water show the double effect of limited depth, in lowering the principal wave-making velocity and in increasing the effects near the velocity of the wave of translation. The results are discussed in their bearing on experimental data for the effect of shallow water on ship resistance.

R. H. FOWLER and C. N. H. LOCK.—*The Aerodynamics of a Spinning Shell.*—Part II. Communicated by H. W. Richmond, F.R.S.

This paper continues and practically completes the analysis of the experiments described under the same title in "Roy. Soc. Trans.," A, Vol. 221, p. 295 (1920). In these experiments shells were fired from two guns giving different degrees of axial spin to the shell. While the shells fired from the gun giving the more rapid spin were all stable, most of the shells from the other gun were slightly unstable, as shown by the much larger yaw developed. These unstable rounds could not be analysed in the first paper as no suitable method was available. They are analysed here and the results confirm previous results for small yaws in a most satisfactory manner, and extend them in certain cases to larger yaws.

In order to carry out this analysis for yaws up to 35° it is necessary to restrict as little as possible the form of the couple assumed to act on the shell at yaw δ . If the couple is taken in the form $X \sin \delta [1 - Y(1 - \cos \delta)]$, where X and Y are constants, a solution of the equations of motion can still be obtained in elliptic functions. This solution is worked out and cast into a practicable form; it proves adequately general and the analysis of the experiments is carried out with its aid.

F. B. PIDDUCK.—*The Kinetic Theory of a Special Type of Rigid Molecule.* Communicated by Prof. S. Chapman, F.R.S.

The accurate methods of Chapman and Enskog in the kinetic theory of gases are applied, with suitable modification, to a type of rigid molecule, with a view to finding how viscosity is affected by energy of rotation, and the relative transport of translational and rotational energy in thermal conduction. The molecule model is one that

has been mentioned by Bryan, a sphere which grips at each collision and rebounds without dissipation of energy. The results lend support to Eucken's views on Chapman's constant f for polyatomic gases.

J. E. JONES, M.Sc., Lecturer in Mathematics in the Victoria University of Manchester.—On the *Velocity Distribution Function and on the Stresses in a Non-Uniform Rarefied Monatomic Gas*. Communicated by Prof. S. Chapman, F.R.S.

The problem of the law of distribution of molecular velocities in a non-uniform gas at normal pressures has been dealt with in recent memoirs by Chapman and Enskog. In the present paper, the case of a rarefied gas has been considered, and the method used embodies certain features which appear to be new. A new "equation of transfer" is obtained which is different in form from that of Maxwell, and which is deduced from Boltzmann's integral equation. The rate of change of molecular properties by collision seems to follow more directly and more easily from this equation than from that used by Maxwell and subsequent writers. From Boltzmann's equation by a method somewhat different from that used by Enskog, a symbolic solution of the velocity distribution is obtained: from the new equation, by an analogous treatment, the exact nature of the function is deduced.

To illustrate the present method, the results obtained by Chapman and Enskog for a normal gas are not assumed, as they might be, but are calculated anew. The treatment is then extended to a rarefied gas and expressions obtained for stresses due to non-uniformity of temperature. The existence of temperature stress terms in a rarefied gas was first demonstrated by Maxwell in the case of his special molecular model, and soon afterwards, by a different method, by Reynolds. There is, however, a discrepancy between the two results.

From the general formulæ obtained in this paper, the results in two special cases are deduced. In the first place, the special Maxwellian model is considered, and Maxwell's result is confirmed: and then, for the first time, the molecular model of a gas consisting of rigid elastic spheres is considered in detail. The numerical coefficient in this case is found to differ by about 20 per cent. from that of the Maxwellian gas.

H. BATEMAN.—On the *Numerical Solution of Integral Equations*. Communicated by Prof. E. T. Whittaker, F.R.S.

A method is developed for obtaining an approximate solution of an integral equation of Fredholm's type by using an approximate representation of the kernel by means of a double series of known functions. It is shown that one such series can be written down immediately in the form of a determinant and the solution of the integral equation with the approximate kernel can also be written down in the form of a determinant. This method is illustrated by means of a numerical example.

Another method is discussed in which the kernel of the integral equation is represented approximately by a polynomial and some methods of obtaining this representation are suggested.

W. B. HARDY, Sec. R.S., and Ida DOUBLEDAY.—*Boundary Lubrication—The Paraffin Series*.

The lubricating properties of normal paraffins and their related acids and alcohols have been studied under the conditions of boundary friction.

Amonton's law, that friction varies as the loads and is independent of the areas, is rigorously true for the same bearing surfaces and lubricants.

The friction is independent of the quantity of lubricant present. It is a linear function of molecular weight, so that $\mu = \text{friction} \div \text{load} = a - bM$ where M is molecular weight. b is a pure function of chemical constitution; the slope of the curve is greatest for acids and is sensibly the same for paraffins and alcohols.

The effect of changing from one acid to another is merely to shift the curves parallel to themselves. Therefore, for the same chemical series, a is a pure function of the nature of the solid faces.

Each solid face contributes one-half of a , so that, when the solid faces are different, say of materials 1 and 2 respectively, $a = \frac{1}{2}a_1 + \frac{1}{2}a_2$.

Each molecule of lubricant present on the faces contributes a constant quantity to the total effect independently of the total number of molecules present.

ROYAL SOCIETY.

LIST OF PROBABLE PAPERS FOR READING ON
FEBRUARY 23, 1922.

C. D. Ellis.— β -ray Spectra and their Meaning. Communicated by Sir E. Rutherford, F.R.S.

- Prof. A. E. Conrady.*—A Study of the Helices. Communicated by Mr. C. V. Doye, F.R.S.
- J. S. Owens M.D.*—Suspended Impurity in the Air. Communicated by Sir Naper Shaw, F.R.S.
- R. V. Southwell.*—On the Free Transverse Vibrations of a Uniform Circular Disc clamped at its Centre; and on the Effects of Rotation. Communicated by Prof. H. Lamb, F.R.S.
- R. Orley.*—Magnetism and Atomic Structure. II. The constitution of the Hydrogen-palladium System and other similar Systems. Communicated by Prof. A. W. Porter, F.R.S.
- T. Garkman and Prof. G. H. Hardy, F.R.S.*—Fourier's Series and Analytic Functions.
- Prof. A. McAlister.*—Muffinons and Differential Invariants. II. and III. Communicated by Mr. W. E. Hardy, Sec. R.S.

“THE INSTITUTION OF RUBBER INDUSTRY.”

MEETING AT MANCHESTER.

“RUBBER MIXES AND THE QUESTION OF ACCELERATORS.”

By *Joseph L. Rosenbaum, M.Sc.*

At the meeting of the Institution of Rubber Industry, held at the Midland Hotel, on Monday, February 6th, Mr. J. H. C. BROOKING, M.I.E.E., presiding, a Paper entitled “Rubber Mixes and the Question of Accelerators,” was read by Mr. JOSEPH L. ROSENBAUM, M.Sc.

Mr. Rosenbaum, at the outset of his Paper, said that he proposed to deal with the question of organic accelerators only, and mention would only be made of the inorganic accelerators and of the natural organic accelerators present in crude rubber in those cases where their presence in the same mix had an effect upon the organic accelerators.

Dealing briefly with the historical aspect of the subject, the lecturer pointed out that it was in the researches relating to synthetic rubber that the foundation stone of our modern knowledge of organic accelerators was laid. Synthetic rubber proved very difficult to vulcanise, and this was found to be due to the absence of the so-called impurities always present in natural rubber. When the traces of protein matter were extracted from natural rubber, the remaining material proved very difficult to vulcanise, and when this protein was added to synthetic rubber, satisfactory vulcanisation was easily obtained. As a natural con-

sequence of this discovery of the marked accelerating properties of traces of organic basic compounds, a search was made to see whether simpler artificially prepared organic compounds could not serve the same purpose.

The first practical result of this search was seen in a patent taken out by the Bayer Company in 1912, in which they claimed the use of piperidine as an accelerating agent. This was followed by several similar patents, and finally, in 1914, a patent was taken out claiming the use as vulcanisation accelerators of all organic basic compounds possessing a dissociation constant higher than 1×10^{-8} . Since that time, hundreds of other compounds have been proposed as accelerators, nearly all of them characterised by being basic products. Particular mention was made of the discovery by Peachey in 1914 of the accelerating properties of the nitroso derivatives of dimethyl aniline, di-ethyl aniline, and similar compounds. These compounds are characterised by their accelerating properties being dependent upon the nitroso group and not upon the basicity.

The short historical survey concluded with a description of the zinc salts of complex organic compounds that have been proposed in America and Italy, and also of the method of Dr. Schidrowitz of producing the catalyst in the rubber.

Mr. Rosenbaum then dealt with the mechanism of action of accelerators. He showed that any heat effect produced by reaction of the organic catalyst and sulphur was very small indeed, and could play but a very subsidiary part in accelerating the speed of vulcanisation. Although no general mechanism of action suitable for all accelerators could be formulated, there was no doubt that in the majority of cases reaction with sulphur occurred, and that complex sulphur containing bodies are formed capable of combining with the sulphur in the mixing, thus liberating it in a condition especially suitable for vulcanisation. What the exact nature of this active sulphur is is not known, but reference was made to the work of certain American chemists who hold that it is thio-ozone, *i.e.*, a form of sulphur bearing the same relation to ordinary sulphur as ozone does to oxygen.

Certain accelerators, such as thiocarbonyl or hexamethylene tetramine, or the complex thiocarbamate class, only exert their maximum efficiency in the presence of

zinc oxide, whereas others, such as nitrosodimethylaniline function quite well in a simple rubber mixing.

A remarkable fact with regard to these organic accelerators is that they exert quite an abnormal effect upon the mechanical properties of the rubber as compared with the amount of sulphur that goes into combination with the rubber. It would seem that these accelerators have some direct effect upon the rubber itself, but numerous experiments have failed to reveal any such action.

A resumé of the more important organic accelerators available to-day was given, and included the piperidine compounds and other thiocarbamate derivatives, thio-carbanilide, hexamethylene tetramine, aldehyde ammonia, p-nitrosodimethylaniline, p-phenylene diamine and many others.

Mr. Rosenbaum then described a group of remarkable accelerators he had discovered during his research work in the laboratories of the Hooley Hill Rubber and Chemical Company. The colour bases of the basic dyes were investigated, and it was found that in many cases not only did they possess very marked accelerating efficiency, but that the colour they produced in the vulcanised mixing persisted during vulcanisation even at high temperatures and in the presence of excess of sulphur. A striking case in point was that of methyl violet base. Then other colour bases were discovered which were very good accelerators, but the colour of which was completely destroyed on vulcanisation. Auramine base is an example of this class. Other bases were found which had very good colouring properties, but which only accelerated to a very insignificant extent. Finally, it was found that all the colour bases of the basic organic dyestuffs accelerated the vulcanisation and/or coloured product. This discovery forms the subject matter of British Patent 141412 of 1919.

Dealing with the question of the practical use of accelerators, Mr. Rosenbaum pointed out that the best commercial results could be obtained by diminishing the quantity of sulphur used in the mixing when an accelerator was used. This point had been realised in America, which country was six to eight years ahead of Great Britain in the technology of rubber vulcanisation acceleration. Accelerators, whilst particularly valuable for their time, steam and labour-saving qualities, had several secondary advantages which were not sufficiently

realised, such as the prevention of sulphuring up or blooming, the improvement of the physical qualities of the rubber, and the improvement in ageing properties. They could also be used in the manufacture of the rubber sheaths for electric cables where it was necessary to have no free sulphur at all in the mixing.

With regard to the toxic properties of accelerators, Mr. Rosenbaum pointed out that these had been rather exaggerated, and showed from his own experience that the use of Accelerene (p-nitrosodimethylaniline) that by efficient supervision and proper selection of workmen, troubles from skin rash and skin irritation could be reduced to a negligible minimum.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

The next Meeting of the Society will be held on Wednesday, March 1st, at the Chemical Society's Rooms, Burlington House, Piccadilly, W., at 8 p.m.

The following Papers will be read:—

"The Theobromine Content of Cacao Beans and Cocoa," by RAYMOND V. WADSWORTH.

"The Determination of Aldehydes and Ketones by means of Hydroxylamine," by LEX. H. BENNETT and F. K. DONOVAN.

"The Value of Fish Scales as a Means of Identification of the Fish used in Manufactured Products," by R. E. ESSERY, B.Sc., A.I.C.

"The Examination of B.P. Ointments," by NORMAN EVERS, B.Sc., F.I.C., and G. D. ELSDON, B.Sc., F.I.C.

INFORMAL DINNER.—Arrangements have been made for Members and their friends to dine together at St. James' Restaurant, 178, Piccadilly (opposite Burlington House) at 6.30 p.m.

THE SOCIETY OF CHEMICAL INDUSTRY. MANCHESTER SECTION.

The Fifth Meeting of the Session was held on Friday, February 3rd, at the Textile Institute, Dr. E. ARDERN, F.I.C., presiding.

Papers entitled "The Estimation of the Nitro Group in Aromatic Organic Compounds, Part 2," and "The Use of Potassium Bromate in Volumetric Organic Analysis," prepared by T. CALLAN, D.Sc., Ph.D., and J. A. RUSSELL HENDERSON, D.Sc., jointly, were read.

"THE ESTIMATION OF THE NITRO GROUP IN AROMATIC ORGANIC COMPOUNDS."

In this Paper, the authors explain that they have extended the work previously published on the estimation of Nitro Compounds (*J. Soc. Chem. Ind.* XXXIX., 1920, 845-851), which dealt with certain difficulties experienced in the determination of aromatic nitro groups by the Knecht-Elliott reduction method. They confirm the results previously given that the use of titanous chloride for this purpose often gives erroneous results owing to simultaneous chlorination and reduction, and give further examples. The use of titanous sulphate eliminates this source of error. The authors have, however, found that titanous chloride containing a minimum amount of hydrochloric acid in presence of an excess of sulphuric acid acts similarly to titanous sulphate, even with substances such as *a*-nitronaphthalene which readily chlorinate. Another source of error in the ordinary procedure for the determination of nitro groups by reduction with titanous salts is loss by volatilisation during the boiling necessary for reduction, so that in many cases quantitative results can only be obtained by working under a reflux condenser. Many examples illustrating these sources of error were given, and the effect of varying the conditions of analysis was also indicated.

p-Nitroaniline was recommended as the ultimate standard against which titanous solutions should be standardised, and it was shown that solutions of sodium nitrite, potassium bromate, nitrodiazobenzene chloride solutions, etc., could also be standardised against this substance, and then could be used for the volumetric determination of a considerable number of hydroxy and amino derivatives of benzene and naphthalene. The advantages of having one ultimate standard, *i.e.*, *p*-nitroaniline for the greater part of the intermediates used in the dye industry were briefly described.

It was shown, contrary to recent published statements, that many substances, in particular mononitrohydrocarbons and their mono- and polychloro-derivatives, could be quantitatively determined with titanous sulphate provided the sources of error above referred to were eliminated, and the experimental conditions described were adhered to. Finally, the results obtained in the analysis of a number of nitro compounds not previously recorded were tabulated.

"THE USE OF POTASSIUM BROMATE IN VOLUMETRIC ORGANIC ANALYSIS."

In this Paper, the authors gave an account of some of the applications of potassium bromate in volumetric organic analysis. The method, which was first used by Koppeschaar in 1876 for the estimation of phenol, and which has since been employed by many experimenters, notably Vanbel, who has shown its wide application for the estimation of amino and hydroxy aromatic compounds and their derivatives, depends upon the absorption of bromine by the compound under analysis when this is supplied in a nascent condition by the interaction of a standard solution of potassium bromate and excess of potassium bromide in presence of a mineral acid. The authors gave a detailed account of the preparation of the potassium bromate solution, its standardisation, and its application to some substituted phenols and anilines.

The three main factors governing bromination by means of nascent bromine are found to be in the case of aromatic compounds (a) orientation of the groups forming the compound, (b) nature of these groups, and (c) the temperature of the reaction. The effect of these factors in a number of typical bromate titrations was discussed.

The application of the method to the direct estimation of dinitrophenol in picric acid, thiocarbanilide, a substance which has become of some technical importance, diphenylamine, and cinnamic acid, where the bromine is absorbed by addition and not substitution, was described, with details of the analytical procedure required.

THE SOCIETY OF GLASS TECHNOLOGY.—The 50th Meeting of the Society of Glass Technology was held at the College of Technology, Dr. M. W. TRAVERS, F.R.S., presiding.

In opening the proceedings, the Chairman said that from very small beginnings the Society had now extended its sphere of operations so as to include a considerable number of members in America, France, Belgium, and Asia. He was not aware of any society of the same size which had such far-reaching influence. Due acknowledgment ought to be paid to such early pioneers in the development of the organisation as Prof. Turner, Prof. Wood, and Mr. Jacobson. He hoped that on the occasion of their 100th Meeting, the Society would find itself occupying an even higher func-

tional position than it did at the present moment.

A Paper, entitled, "The Relative Advantages and Disadvantages of Limestone, Burnt Lime, and Slaked Lime as Constituents of Common Glass Batches containing Soda-Ash and Salt-Cake," Part 2, by F. W. Hodkin, B.Sc., A.I.C., and Prof. W. E. S. Turner, D.Sc., was read by Prof. Turner.

The authors stated, in continuation of a Paper read 12 months previously, that, in practice, glass manufacturers, particularly of tank-made glass, had used different forms not only of alkaline material, but also of the lime which constituted the soda-lime glasses. In regard to the alkali it might be supplied in the form of soda-ash or of salt-cake, or, in some cases, of a certain mixture of the two. In the case of the lime it might be burnt lime, slaked lime, or calcium carbonate, which might be limestone or spar, according to the chalk, or some similar form, which after all was the best practice under differing conditions.

In summing up the conclusions of the paper, Prof. Turner said that the melting down of glass was dependent upon a number of conditions, *i.e.*, upon the form of alkali used, the form of lime used, and the relative amounts of lime and soda used. In the case of glasses such as those made for common bottles and used with automatic machines, the soda-ash-burnt lime appeared to be the most readily melted, while the salt-cake-burnt lime was perhaps the slowest. When, however, one dealt with a lime containing glass approaching window glass, or at any rate with an additional 4 per cent. of lime, the form in which the glass melted down was not the burnt lime, but the slaked lime, and that, generally speaking, was the form of alkali employed. With lime-containing glasses, melting could be assisted very considerably by the addition of small quantities of other oxides, particularly magnesia.

A second Paper, entitled, "The Density of Soda Magnesia Glasses and the Calculation of Density in General," by S. English, M.Sc., A.I.C., and Prof. W. E. S. Turner, D.Sc., was taken as read.

ROYAL INSTITUTION. — On Tuesday (February 21) at three o'clock, Sir Arthur Keith began a course of five Lectures at the Royal Institution, on "Anthropological Problems of the British Empire," Series I., "Racial Problems in Asia and Australasia." The Friday evening Discourse on February 24 will be delivered by Professor John Joly, on the "Age of the Earth."

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

LECTURES BEFORE EASTER, 1922. FRIDAY EVENING DISCOURSES

February 24.—John Joly, D.Sc., F.R.S., Prof. of Geology, University of Dublin.—"The Age of the Earth."

March 3.—C. Morley Wenyon, C.M.G., C.B.E., M.B.

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—"Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—"The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—"Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of "Drama and Life," etc.—"Jane Austen."

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—"Evolution of the Elements."

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the EDITOR.

SUBSCRIPTIONS £1 12s. per annum, payable in advance, should be addressed to the MANAGER. BACK NUMBERS and VOLUMES can be purchased on application to the MANAGER.

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New Patents.

This list is specially compiled for *Chemical News* by Messrs. Logan & Co., Registered Patent Agents, at 5, CHANCERY LANE, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 158,700 Ashcroft, J. A. Precipitation of precious metals from organic solutions containing formal. Jan. 31.
158,701 Allen, J. W. Process for sulphurising organic compounds. Jan. 31.
158,702 Saymore, W. Manufacture of azo-dyes. Jan. 31.
158,703 Forrester, G. H. C. Production of phosphoric acid. Feb. 1.
158,704 Johnson, J. C. Process for manufacture of lactic acid with recovery of gases of condensation. Feb. 2.
158,705 Watson, T. W. Manufacture of anthracene. Jan. 31.

Specifications Published this Week.

- 174,000 Brown, A. J. Process of separating alcohols into acids from the by-products accompanying their production, and the manufacture of soaps from these acids.
174,101 Davis, M. O. Manufacture of oxy-derivatives of anthraquinone.
174,174 Hanson, W. H. Manufacture of leuco aliphatic boranes and derivatives therefrom.
174,216 John, H. Process for the manufacture of condensation products of formaldehyde and carbonic derivatives.
174,243 Johnson, J. Y. Process and apparatus for the extraction of sulphur.

Abstracts Published this Week.

Sulphuric Acid—Patent No. 173,060.—A new process and plant for producing Sulphuric Acid has been devised by Mr. C. J. Road, of 307, West Glasside Avenue, Glosside, Pennsylvania, U.S.A. A gaseous mixture of sulphur dioxide, nitric oxide or other higher oxide of nitrogen and air or oxygen is heated, for example, to 290-600°C., and the resulting compounds produced by the union of sulphur trioxide with the nitrogen oxides are absorbed in concentrated sulphuric acid. Sulphuric acid is liberated and nitrogen oxides recovered for re-use by treating this solution, separating in a second absorber with water equivalent to the sulphur dioxide used.

Messrs. Logan & Co. will obtain printed copies of the published specifications and forward on application the official price of 1s. each.

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SINGAPORE STRAITS SETTLEMENTS.

CEMENT WORKS—CHEMIST.

WANTED, for a Cement Work recently completed in Singapore, a Chemist with an intimate knowledge and experience in the manufacture of Portland Cement by the wet process, and familiar with the conduct of analyses of fuel and flue gases, and all the details pertaining to the duties of a Chemist in a modern Cement Factory. There are two rotary kilns, 125 feet, Mills, Griffin, Tube, Electric drive. Only fully experienced men need apply.

Salary £900 to £1,200, according to experience, with furnished house at the Works, use of Motor Car, and bonus; four years' agreement, excellent prospects for good man.

Applications, stating age, place of birth, and giving details of education, training, and experience generally, referring particularly to the above requirements, with dates, and accompanied by Copies of not more than six testimonials, must be lodged with MESSRS. C. C. LINDSAY & PIERCE, 180, Hope Street, Glasgow (who will supply further information if desired), not later than Tuesday, 28th February.

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TO BE SOLD, a Modern Red Brick and Tiled RESIDENCE, standing on high ground, with well timbered and very pretty garden of about 1½ acres. 2 Reception Rooms, Conservatory, 5 Bedrooms, 2 Bathrooms, 3 Attics. Company's water, Telephone. A feature of the property is a newly-erected Laboratory on two floors, fitted with electric light, heating and other appliances, which could easily be adapted as a garage with rooms for Chauffeur, Rookery, Tennis Lawn, and Small Garage.

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(14745)

CHEMICAL STUDENT, age 18, pass Inter Sc. Exam., seeks situation near London in Chemical Trade or Laboratory.—Write W. P., 42, Dingwall Road, Croydon.

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3229.

POSITION OF COAL INDUSTRY.

HOPEFUL OUTLOOK.

One of the worst disservices that could be rendered to our national trade as a whole is to misrepresent the position of the coal-mining industry—the foundation upon which British prosperity has been built.

It is scarcely the fault of large numbers of people if they now actually believe that the industry is doomed, and that the conditions of the workmen in respect of unemployment and wages are indescribably bad. They have derived their information from persons who themselves have little or no knowledge of the actualities of the situation.

The truth is that the industry has been passing through a critical time, but the outlook is now sufficiently promising to justify the hope and expectation of greatly improved conditions in the not remote future. Compared with a year ago, coal to-day is cheap, and the demand, particularly from overseas consumers, distinctly better. It is true that we have not yet reached the pre-war level as regards either prices or volume of trade, but the fact remains that we have made considerable progress along these lines towards economic recovery.

The recapture of the overseas markets formerly held by this country has, however, not been achieved without cost; indeed, the process has involved for the time being the necessity of low wage rates for the miners and the surrender of the owners' profits. Employers and men have had to make common sacrifice in order to set the wheels of industry moving. Export coal prices have been forced down to a competitive level, and this has, in many cases, entailed loss to British exporters, who have wisely adopted the far-sighted policy of re-establishing themselves in overseas markets and relegating price to a secondary position. The vital importance of these markets to Great Britain is realised by every student of economic questions. Their loss would entail the restriction of imports of food and raw materials into this country, and would thus aim a deadly blow at our manufacturing trades, besides forcing up the cost of living.

The system of wages regulation embodied in the Terms of Settlement has resulted in successive reductions in the payments made to the miners, while it has absorbed practically the whole of the profits of the industry. But it is clear that had this expedient not been adopted, there could have been no forward movement in the industry such as is now taking place.

Moreover, the careful adjustment of wage-rates periodically has had the effect of minimising unemployment among the men. It is little realised that in none of the great industries is there such a proportionately small number of men drawing the "dole" as in coal mining. This is shown by the latest available official figures, which are given in the *Labour Gazette* for January. At the end of last year the estimated number of insured workpeople in the industry was 1,140,670, of which number there were 126,348, or 11.1 per cent., unemployed. Against this, the percentage of unemployed in the iron, steel and allied trades is given as 36.7, for other metals 29.5, and for the cutlery trade 35.1. In the cotton trade there were 98,965, or 17.1 per cent., unemployed out of a total of 577,710, and in the flax, linen, and hemp sections the proportion was 21.2. Ship-building, engineering, building, and works construction also show percentages vastly in excess of that of the mining industry.

These trades have had the advantage of the substantial lowering of coal prices, secured at the expense of coal owners and their workpeople, but nevertheless a very considerable proportion of the persons engaged in them are now being maintained at the expense of the taxpayers. On the other hand, the mining industry, despite the gloomy pictures painted by the alarmists, is not far from being self-supporting, and is, in an economic sense, in a healthier state than it has been within recent years.

THE ATOMIC THEORY IN 1921.

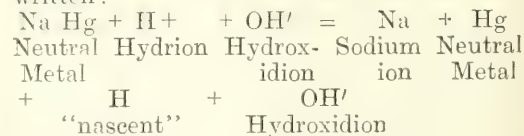
Presidential Address, Section B., S. African Association for the Advancement of Science. Durban, by James Moir, M.A., D.Sc., F.R.S.S.A., F.I.C., F.C.S.—In thanking you for the honour of being elected President of this section, I take the opportunity of explaining why I deviate from the customary rule that a presidential address should not resemble an ordinary scientific

paper, but should be of more general interest, in fact not unlike a popular science lecture. The fact is, however, that in the five years since I wrote a presidential address. There has been such a tremendous upheaval of the foundations of chemistry and physics, that it is desirable that someone should take the trouble to assimilate the new views and put them in record in a connected form for the use of South African scientists. This must be my excuse for not attempting the kind of address which might be crystallised in the phrase, "Science for Stoolbrokers." The revolution which has taken place is one of very great philosophical interest, and is, briefly speaking, the reduction of chemistry to a branch of physics. This has taken place in three logical steps, the first being the recognition of the fact that all chemical properties of a compound can be explained by the number and the arrangement of the *chemical valencies* of the different elements contained in the compound. All chemical properties are thus referred to the properties of the 92 *chemical elements*, with the addition of special phenomena solely connected with the *arrangement* of elements among one another. The second step is the periodic law of the elements, whereby the 92 elements are shown to have only about 10 *different kinds of valency* amongst them. The model atom was invented to explain this. It consists of a hollow sphere containing a minute heavy Kernel* with a distant ring or shell of electrons, each of which gives a valency; the shell may consist of any number of electrons between 1 and 10, the number and arrangement thus explaining all the possible kinds of valency, and therefore all the strictly chemical properties. The third step consists in showing that the remaining (non-chemical) properties of the atom, such as weight, depend on the nature of the atom-nucleus. The nucleus of certain familiar chemical elements has recently been broken down by artificial means, thus showing that the atom is not the indivisible minute sphere that it was supposed to be in the 19th century, but is itself a compound of smaller bodies in a special arrangement. Nitrogen, for example, is shown to consist of four particles of weight 3, along with two hydrogen atoms, each being characteristically charged with positive electricity, and the whole being held together by "binding nega-

tive electrons" to give mass 14 and charge 5. The particle of mass 3 is also almost certainly itself a combination of 3 hydrogens and an electron. Chemistry and physics, therefore, now depend on two substances only, instead of, as before, on the 92 elements of the chemist. The fundamental conceptions of the new atomic theory are those connected with hydrogen in its three forms, viz. (1) hydrogen-ion (hydrion), the cause of acidity; (2) nascent hydrogen and (3) free hydrogen gas.

A. Hydrion is the fundamental and only weight-substance: it consists of unit weight accompanied by unit positive electricity ($=1+$); and all the elements, following Prout's hypothesis of 100 years ago, are associations of hydrion with electrons ($=0-$) in different numbers and arrangements. The function of the innermost electrons is to hold the hydrions together, and this the electrons can do even if they are less in number than the hydrions. This combination of a number of hydrions with a *smaller* number of electrons constitutes an atomic nucleus, which thus possesses a positive electric charge equal to the difference between the numbers of hydrions and electrons present. Thus the nucleus of the element Lithium is conceived to consist of seven hydrions held together by four electrons, and this nucleus, therefore, behaves as possessing 7 units of weight* and 3 positive charges. It is to be noted that the size of the hydrion is somewhat smaller than that of the electron, the diameter of which is 4×10^{-13} cm.

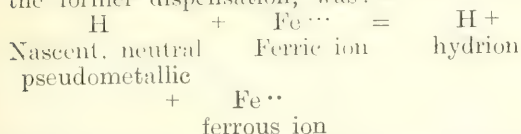
B. Nascent hydrogen in this system is merely atomic as opposed to molecular hydrogen, i.e., it is half of whatever molecular hydrogen (hydrogen gas) is conceived to be, consequently it will clear matters up if we consider a simple case, such as that of adding sodium-amalgam (containing very little sodium) to a solution of ferric chloride. In the first half of the action, assuming sufficient dissociation of the water, nascent hydrogen is formed according to the equation, which used to be written:—



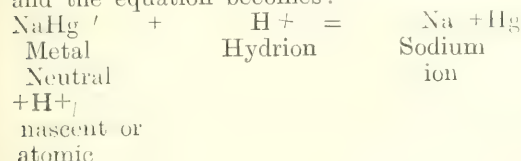
* The electron is assumed to be weightless: it is in fact $\frac{1}{1800}$ of hydrion.

* The difference between Kernel and Nucleus is defined later on.

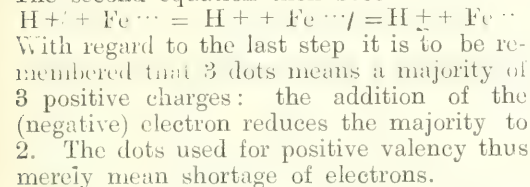
Similarly the second equation, according to the former dispensation, was:—



Now on the modern theory, hydron is the absolute proton or fundamental unit of matter, and its positive charge is inherent in it and inseparable from it. It follows, therefore, that "nascent hydrogen" is not *uncharged* H, but is *neutral*, viz., $\text{H} + /$, i.e., hydron with an electron joined to it. (See Fig. 1.) In order, therefore, to be able to re-write the first equation in the modern way, we must provide an electron, and the equation becomes:—



The second equation then becomes:—



C. Hydrogen gas or molecular hydrogen is known from its ρ/v ratio to have a long molecule, far removed from roundness, and since it results from "nascent hydrogen" without addition or subtraction of electricity, its formula must be $(\text{H} + /)_2$, viz. $(\text{H} + // \text{H} +)$, i.e., it consists of two pairs of entities, one being hydron and the other the electron. Now the spatial arrangement of these 4 things cannot be square or tetrahedral, otherwise the molecule would not be "long." It must therefore be either a straight line or a narrow-diamond shaped figure, viz., either (see Fig. 2). We now meet with the chemical fact that lithium hydride exists and that it is at first glance composed of two positive substances Li and H, which is impossible owing to electrical repulsion. Further, in both the above formulations of hydrogen gas the electrons are close together, which also is contrary to hypothesis, since both are negative and would repel one another. Lithium hydride is a sale-like non-metallic material made from lithium metal and

hydrogen gas, both of which are electrically *neutral* (not positive): we must therefore assume the equation $\text{Li} \cdot + \text{H} + / = (\text{Li} // \text{H} +)$, in which the arrangement of the electrons is the same as in hydrogen gas. It is stated, however, that when LiH is melted and electrolysed, lithium metal appears at the cathode and hydrogen gas at the *anode**. Now the cathode is negative, hence the appearance of lithium metal ($\text{Li} \cdot$) is normal, but at the anode we must assume that $(\text{H} +) //$ forms a *negative* ion attracted there (see Fig. 3), and that it then loses an electron to the positive anode, giving $\text{H} +$ which is nascent hydrogen. We are thus again led to the assumption that hydrogen gas consists of the positive $(\text{H} +)$ joined to the negative $(\text{H} + //)$ (see Figs. 2, 1 and 3). Some writers get over the difficulty by dissecting the electron itself into a repulsive electric part and an attractive magnetic part, but this is at present scarcely credible. Similarly, in methane and other inactive hydrogen compounds, one has to assume that carbon parts with 4 electrons to 4 neutral H atoms giving 4 distant $(\text{H} +) //$ groups round the carbon kernel; whereas, on the contrary, in a hydrogen-compound which is a tetrabasic acid (e.g., H_4SiO_4) the hydrogen outside consists of plain hydrons $(\text{H} +)$ and the 8 electrons left over are pushed inside close to the kernel, thus $(\text{H} +)_2 \text{---SiO}_4 \text{---} (\text{H} +)_2$. Having now dealt fully with hydrogen in its different phases, let us now consider what is the nature of another simple monovalent element. Taking lithium as the simplest case, we remember that we have carried at the conclusion that it consists of a small nucleus composed of 7 hydrons held together by 4 electrons, giving a total positive nucleus charge of 3. Since lithium *metal* is neutral, and lithium in the ionised state positively monovalent, we see that the nucleus must carry two negative electrons just outside it. This combination of nucleus and close electrons is called the "kernel" of the atom. The "kernel" is the same as the "ion" when there are not many outside electrons. Thus lithium *ion* Li is $\theta(4\text{H} + + \theta + 3\text{E} + \theta)$, in which θ is the electron. It has 7 plus and 6 minus charges, therefore has +1

* Hydrogen appears at the cathode in the electrolysis of water, &c.

valency. Lithium metal is the foregoing Li^+ with a seventh electron at a comparatively great distance, viz. $7(411 \times 10^{-11} \text{ cm.})$ making it absolutely neutral. Now the number 3 in the case of lithium, which is both the nuclear charge and the total of the number of external electrons (in this case 2+1) coincides with the fact that in the periodic law is authoritatively written, lithium is the third element in order. Similarly beryllium, the fourth element in the ordinary periodic law, has a nuclear charge of 4, and a total of 4 external electrons. Sodium is 8 places higher than lithium, therefore has a nuclear charge of 11 ($3+8$) and 11 external electrons. The nuclear charge of +11 is the difference between 23 electrons (giving the weight) and 12 electrons; and as regards the eleven external electrons it is assumed that 10 of them are close to the nucleus, forming along with the nucleus the "kernel" (or "ion") of sodium. Thus Na^+ (the ion) is $50(12\text{H} \cdot 129 \times 10^{-11} \text{ cm.})$, and sodium metal is this kernel with a separate electron at a greater distance, as in the case of lithium. In order to bring out the complete analogy between sodium and lithium it is assumed that the 10 external electrons are arranged so that 2 of them are just outside the nucleus and the other 8 are about twice as far away, all equidistant from the centre, and therefore arranged something like the 8 corners of a cube round the nucleus. This arrangement of 8 electrons, the conception of which is due to Gilbert Lewis, and which is technically called a "completed octet" is assumed from its perfect symmetry to confer chemical inertness, and as a matter of fact sodium ion, except towards electricity, is quite as inert as argon, going through all sorts of chemical actions unchanged. Similarly potassium ion K^+ is $100(20\text{H} \cdot 209 \times 10^{-11} \text{ cm.})$ in which the nucleus with 19 plus charges (potassium is 8 above sodium, viz. is the 19th element) has 18 external electrons, viz., the arrangement of 10 which exists in sodium, along with another "completed octet," thus giving another kernel or ion which has no valency and is therefore inert.

(To be continued.)

CHEMICAL NOTICES FROM FOREIGN SOURCES

NEW METHOD OF DETECTING COCO FAT IN BUTTER.—*C. F. Muttonet*.—The author has already pointed out that the presence of a vegetable fat in a fat of animal origin can be detected by determining the melting point of the phytosterine formed. Thus the phytosterine from coco fat gives an acetate which melts at 125° , while the phytosterine characteristic of animal fats possesses an acetate which melts at $114-114.2^\circ$. In order to detect coco fat in butter, the fatty acids are first treated with digitonine when a precipitate of the digitonide crystallises out. After heating, this is filtered off, washed with chloroform and ether, and then dried. It is then gently boiled with acetic anhydride, and the melting point is determined. In the case of pure butters the melting point of the acetate of cholesterol lies between 113.6 and 114.2° . If coco fat is present, the melting point of the mixtures of the acetates of cholesterol and phytosterine increases progressively with the amount of coco fat present. If 5 per cent. of the adulterant is present the melting point is 114.6° , while if the proportion present is 30 per cent. the melting point is 118° .—(*Comptes Rendus* CLXXIV., 1922, No. 4.)

AUTO-OXIDATION: ANTIOXYGENES.—*Charles Mourou and Charles Duprais*.—The auto-oxidation of many substances can be stopped by the presence of traces of certain compounds, to which the authors have given the name antioxygens. The faculty seems to be associated with the phenol function. Thus traces of hydroquinone are sufficient to prevent benzoic aldehyde from fixing oxygen. The action seems to last practically indefinitely, and it appears to be of the nature of catalysis. It is not impossible that the therapeutic effects of phenols may be connected with their antioxygenic powers. — (*Comptes Rendus* CLXXIV., 1922, No. 5.)

TWO NEW MOLYBDO-MALATES OF AMMONIUM.—*E. Darmon*.—The study of mixtures of varying proportions of MoO_3 , $\text{C}_4\text{H}_6\text{O}_5$ and NH_3 by the polarimetric method shows that two *lævo* rotatory compounds exist of composition $\text{MoO}_3 \cdot 2\text{C}_4\text{H}_6\text{O}_5 \cdot 2\text{NH}_3$ and $\text{MoO}_3 \cdot 2\text{C}_4\text{H}_6\text{O}_5 \cdot 4\text{NH}_3$ respectively. The

former is fairly stable, while the latter is formed only in presence of excess of neutral ammonium malate. The corresponding compounds of sodium and potassium have been isolated. The compounds having the second formula are rather less active than the first. They are decomposed by bases, and the corresponding acids are slightly less *laevo*-rotatory than the salts.—(*Comptes Rendus*, CLXXIV., 1922, No. 5.)

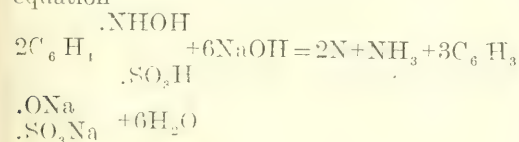
ACTION OF SODIUM SULPHITE ON NITROBENZENE.—*MM. Seyewetz and Vignat*.—When a solution of sodium sulphite containing 10 to 20 per cent. of Na_2SO_3 is boiled with nitrobenzene in the proportion of two molecules of sulphite to one of nitrobenzene, the colour turns first orange then reddish brown, and oily drops appear, while the smell of nitrobenzene can no longer be detected. Ammonia is set free as the nitrobenzene is decomposed. Organic solvents extract nothing from the solution. In order to isolate the product the excess of alkaline sulphite must first be neutralised with hydrochloric acid. Then the solution is concentrated till a crystalline mass is obtained, which is extracted with alcohol. After recrystallisation colourless insoluble infusible crystals are obtained. The aqueous solution (obtained by heating) decomposes, carbonates, has an acid reaction, instantly reduces ammoniacal silver nitrate in the cold, and in presence of alkalis develops a latent photographic image. It is coloured violet by iron perchloride. The compound may be a sulphonie amidophenol

of formula $\text{C}_6\text{H}_4 \begin{smallmatrix} \text{SO}_3\text{H} \\ \text{OH} \\ \text{NH}_2 \end{smallmatrix}$. It is possible that

first of all reduction gives a sulphonie phenylhydroxylamine, according to the equation

$$\text{C}_6\text{H}_5\text{NO}_2 + 2\text{Na}_2\text{SO}_3 + \text{H}_2\text{O} =$$


This unstable hydroxylamine is immediately transformed into orthosulphonie paramidophenol. The liberation of ammonia can be explained by supposing that the soda liberated during the sulphonation on the sulphonie phenylhydrazine, according to the equation



The red colouration produced is due to the formation of azoxybenzene. It is possible to suppress both the red colouration and the liberation of ammonia by adding sodium bicarbonate to the solution of sulphite, and thus transforming it into sodium carbonate.—(*Comptes Rendus*, CLXXIV., 1922, No. 5.)

SEPARATION OF MERCURY FROM COPPER BY ELECTROLYSIS.—*W. Böttger*.—The separation of mercury from copper by electrolysis is easily performed when the two metals are present as nitrates (either mercuric or mercurous salts). The difference of potential between the cathode and the liquid should be 1.4 volt, and the solution should contain 1 to 3 cc. of nitric acid (density 1.4) and 3 cc. of alcohol to about 80 cc. of liquid. The separation is complete at the end of 20 to 30 minutes. When there are chlorine ions in the solution the separation is not complete, and even when ammonia and potassium cyanide are present the values found for copper are always too high.—(*Zeitschr. f. angew. Chem.* XXXIV., 1921, No. 25.)

GENERAL NOTES.

TENDERS INVITED. — *Tinplates, solder, etc., for the Serb Croat Sloveno Kingdom.*—The Commercial Secretary to His Majesty's Legation at Belgrade reports that tenders are invited for the supply free at petroleum store warehouse at Belgrade, of tinplates, tinned wire, solder, etc., required by the Direction of State Monopolies, Belgrade. Sealed offers will be received up to 11 a.m. on the 11th March, and must be addressed, "Uprava Drzavnih Monopola," Belgrade, and marked "Ponuda za Isporuku Materijala za Radionicu Kanti," but should be presented by a representative of the tenderer in order to have a reasonable prospect of success.

A deposit of 10 per cent. of the total amount of the tender is required.

The goods required include:—

1. 30,000 (thirty thousand) kilogrammes of tinplates, 0.32 mm. in thickness, in thickness, in sheets of 250 x 250 mm.
2. 90,000 (ninety thousand) kilogrammes of tinplates, 0.32 mm. in thickness, in sheets of 500 x 370 mm.
3. 150,000 (one hundred and fifty thousand) kilogrammes tinned iron wire of 4 mm. diameter for handles.
4. 3,500 (three thousand five hundred)

kilogrammes of pure solder for soldering tins.

5. 3,500 (three thousand five hundred) kilogrammes of pure lead for soldering tins.

6. 30 kilogrammes (thirty lbs.) "miscellaneous" (unclassified) tin pieces.

7. 250 (two hundred and fifty) kilogrammes of spoils of salt.

Each tenderer must submit samples of the material offered. The following are the quantities required of samples:—One sheet of tinplate, 1 metre of wire, 250 grammes each of lead, solder, sal ammoniac and spirits of salts.

A translation of the conditions of tender is available for consultation by United Kingdom firms on application at the Department of Overseas Trade (Room 84), 35, Old Queen Street, London S.W.1. up to 1922, January, when it will be sent to provincial firms in order of application.

The Department is prepared to assist United Kingdom firms in the appointment of sub-agent, or will give names of firms with branches in the Serb-Croat-Slovene Kingdom who may be prepared to handle tenders on behalf of third parties.

Department of Overseas Trade.

35, Old Queen Street.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE is issuing a new series of Reprints, beginning with a selection of communications given at the Edinburgh meeting, 1921, including:—(1) Science and Ethics, by F. H. Griffiths, Sc.D., F.R.S., 9d.; (2) Discussion on the Structure of Molecules, 9d.; (3) Report on Credit, Currency, Finance and Foreign Exchanges, 1s. 6d.; (4) Report on Complex Stress Distributions in Engineering Materials, 3s. 6d.; (5) Report on Charts and Pictures for use in Schools, 1s.; (6) Report on the practicability of an International Auxiliary Language, 1s.; (7) Report of the Conference of Delegates of Corresponding Societies, including Sir Richard Gregory's address on the Message of Science, 2s. These are on sale at the office of the Association, Burlington House, Piccadilly.

We have received a copy of one of the "reprints" named in the above list. It is a reprint from the Report of the Meeting, with page number, as it will appear in the *Proceedings*. It will be a convenience to be able to obtain copies of the B.A. communications separately, but it is difficult to

understand why the publishing committee have decided to issue it in such a very striking cover; it is so very unlike a scientific memoir.

REAGENT TO DETECT ACETYLENE.—This reagent, given by N. G. Deniges, consists of Hydrochlorate of ammonia, 50 grammes. Crystallised copper sulphate, 25 grammes. Pure Hydrochloric Acid, 0.5 c.c. Water, 2.S. to make 250 c.c.

It does not decompose. For employment, 4 to 5 cc. are boiled with 0.3 to 0.4 gr. of copper, and when the liquid is decoloured it is allowed to cool. Bands of filter paper are dipped into the liquid. Whilst yet humid they turn red in presence of acetylene. With acetylenic mono-substitutes the colour is yellow tinted.—(*Bull. Soc. Chim. II.*, 1921; p. 1272.) *Revue de Chimie Industrielle*, Jan., 1922.

A NOTE ON THE BIURET REACTION.—By *Claude William Bourlet, Walter Thomas, and Molly Lindblad.*—The Biuret reaction is so extensively employed in testing for Peptones and Proteins that it appears surprising that it has received so little attention.

Usually the colour developed is ascribed to "The purple cupric salt of Biuret, the amide of Allophanic Acid, $\text{NH}_2\text{-CO-CONH}_2$."

Prima facie this appears highly improbable. Cupric salts are, almost without exception, blue or green, and although we are acquainted with the double chloride of Copper and Lithium, which is red, and the cupric salts of certain organic acids, which are quite yellow, the existence of a purple copper salt requires strong confirmation.

Subsequent to adding the copper salt the following changes, in the following order, are found to occur in carrying out the reaction experimentally:—

1. The formation of a blue colour throughout the liquid.
2. The change of this blue colour to the characteristic purple colour of the Biuret test.
3. The change of this purple colour to red on standing for some time.
4. The formation of a red precipitate.

This precipitate has been analysed and found to consist of Cuprous oxide.

We have found, too, that the velocity of colour change is greatly accelerated by the addition of electrolytes or neutralisation.

These facts, taken in conjunction, seem to point out that the purple colour is due to the formation of a colloidal solution of Cuprous Oxide.

This view is supported by the fact that the colour can be exactly duplicated by the reduction of copper salts with Glucose in the presence of a peptising agent (Gum Arabic, Starch or Dextrin).

In these cases no Biuret at all can be present.

Finally, as a result of these considerations, we would suggest that the *modus operandi* of the Biuret Reaction is as follows:—

The initial reaction is the formation of Cupric Hydroxide. This is reduced to Cuprous Hydroxide by the Biuret Peptones or other ameno compounds. Alternatively, the Cupric salt of Biuret may be first formed and reduced to the Cuprous salt, and decomposed with the formation of Cuprous Oxide.

BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION.—Engineers, whether they build locomotives, ships, or engines of any kind, are among the largest users of non-ferrous metals, and will recognise the important work being conducted by the British Non-Ferrous Metals Research Association, of 71, Temple Row, Birmingham which has just issued its second annual report. The Association has a membership of over 100 firms, all over the country, including both manufacturers and users of non-ferrous metals. The researches in progress are of a very varied character, and are in many cases of national importance. Apart from investigations of particular importance to the non-ferrous industry itself, such as those on brass casting and on the influence of impurities on the working properties of copper, which latter is being conducted at the National Physical Laboratory by Dr. W. Rosenhain, investigations of more general interest to engineering firms are those on metal polishing and grinding, and on the jointing of metals. The electric melting of non-ferrous metals is also receiving attention, and the Association is performing a public service in conducting its important work on the atmospheric corrosion of non-ferrous metals.

Only by co-operative effort on the lines on which this Association is working can British manufacturers hope to meet the very serious competition which will arise from America and Germany through the

technical advances being made in the preparation and treatment of non-ferrous metals. This report is a reassuring indication that the value of research is being more generally recognised by British manufacturers.

This week's *Manchester Guardian Commercial*, in an article on new uses for rubber, says there is a prospect that recently begun experiments in paper-making from rubber will be successful. The writer says:—"Many highly desirable qualities in paper—such as strength, bursting strength and folding resistance—which paper-makers aim at, can be expeditiously given to the paper by the introduction of very small quantities of rubber in the latex form. By increasing the quantity in the final product, and using specific fibres, latex papers of very exceptional properties may be produced. This entirely new use for rubber can give a new stimulus to rubber production, and the ultimate extension of the benefits of rubber and industrial interchange in the rubber growing areas in the far east. As rubber latex, when used in paper-making, greatly strengthens many kinds of paper, it will be seen that the opportunity is offered greatly to extend the use of some of the hitherto little regarded fibres which can be obtained in many parts of the Empire. It has been estimated that the paper-production of the world is about 10,000,000 tons a year, and, therefore, if rubber latex was used in the manufacture of half the total, viz., 5,000,000 tons, to produce paper with an average content of 1 per cent. of rubber, 50,000 tons of rubber would be absorbed. Over and above this would be the new uses for paper, and of rubber-containing goods made on a paper-making machine. The use of rubber latex in paper-making has the great advantage that it requires no additional expense in the paper-making process as to new machinery and methods, nor does it interfere with the routine and labour in the mills.

THE PHYSIOLOGY OF PROTEIN METABOLISM.

By E. P. Cathcart, M.D., D.Sc., F.R.S.
New Edition. P.p. 176. Monographs on Biochemistry. London: Longmans, Green & Co. Price 12s. 6d.

The second edition of this well written monograph follows very closely the lines of

the first edition, which appeared in 1912. Many of the sections have been re-written in order to bring the book up to date, and to give the work of the past ten years its correct setting. There is only one structural alteration, and that is towards the end of the book, where the sections dealing with the part played by carbohydrates and fats in protein metabolism have been removed from the chapter on "Wick" and made to form the material for an extra chapter bearing the title, "The Influence of Carbohydrates and Fats on Protein Metabolism."

The work of Dutton and his collaborators, and still more recently that of Hewitt and Peck, on the importance of molecular structure in metabolism is specially referred to. The author maintains that the molecular structure of food substances has more bearing on certain phases of protein metabolism than the thermochemical changes involved. The importance of the accessory food substances and their influence upon the satisfactory utilization of foodstuffs by animals is mentioned, but the subject is only briefly discussed, as it is proposed to publish a monograph dealing specially with this subject.

The publishers have accomplished their part of the task well, and there is little doubt but that all those interested in this subject will be deeply grateful to the author for the new edition of this excellent monograph and for the exhaustive bibliography which it contains.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.—*Held March 2, 1922.*

PROF. L. N. G. FILON, F.R.S., and H. J. JESSOP.—On the Stress-Optical Effect in Transparent Solids strained beyond the Elastic Limit.

W. E. CURTIS.—The Structure of the Band Spectrum of Holmium. Communicated by Prof. W. M. Hicks, F.R.S.

S. DARRA.—The Spectrum of Beryllium Fluoride. Communicated by Prof. A. Fowler, F.R.S.

W. G. PAMER.—The Catalytic Activity of Copper. Part III. Communicated by Sir W. Pope, F.R.S.

C. H. GERRARD, D.Sc.—The Motion of Ellipsoidal Particles immersed in a Viscous Fluid. Communicated by Prof. L. N. G. Filon, F.R.S.

H. B. JEFFREY, D.Sc.—The Rotation of

two Circular Cylinders in a Viscous Fluid. Communicated by Prof. L. N. G. Filon, F.R.S.

Provisional Report.

THE ROYAL SOCIETY.—*Ordinary Meeting—February 16, 1922.*—*Sir Charles Sherrington, President, in the Chair.*—The following papers were read, the summaries here printed having been supplied by the authors for use at the Meeting:—

PROF. L. HILL, F.R.S., D. H. ASH, and J. A. CAMPBELL. On the Heating and Cooling of the Body by Local Application of Heat and Cold.

Experiments in which the hands were heated or cooled by water showed that the amount of heating or cooling was large, but not constant for a given range of temperature. Some indication of the degree of heating or cooling was obtained from the temperature of the skin over the median vein at the elbow, the thermometer used being coiled and insulated from the air. Loss of 20 to 25 kilo-calories of heat from the hands in 30 minutes, i.e., a loss almost equal to the basal metabolism, did not appreciably affect the body metabolism.

PROF. J. B. COHEN, F.R.S., C. H. BROWNING, R. GAUNT, and R. GULERANSEN. Relationships between Antiseptic Action and Chemical Constitution, with Special Reference to Compounds of the Pyridine, Quinoline, Acridine and Phenazine Series.

(1). Certain acridine derivatives (salts of diamino-acridine and the methochloride of this base) are extremely potent antiseptics. Their action is not diminished by protein solutions, such as serum. With a view to studying the relationships between chemical constitution and antiseptic action in the acridine group a series of substances have been investigated, comprising pyridine and quinoline derivatives ("fragments" of the acridine molecule), a number of acridine derivatives, and the closely allied phenazine compounds. None of the "fragments" approximated to diamino-acridine in antiseptic properties. The amino-phenazine derivatives were in general weaker antiseptics than those of diamino-acridine.

(2). The substances of the acridine group which have been investigated gave the following general results:—

(a) The presence of amino groups increases antiseptic power.

(b) Effectiveness in a serum is a characteristic of compounds with unsubsti-

tuted amino groups and especially of the methochloride of these bases.

- (c) In the presence of serum the methochloride is never less potent as an antiseptic than the hydrochloride. In certain instances the methochloride shows a striking superiority.
- (d) A series of other radicals introduced in place of the methyl group in the methochloride does not alter the antiseptic action (ethyl, propyl, *n*- and *iso*-butyl, &c.; chloroacetate, chloropropionate, and acetanilide derivatives have also been examined).
- (e) Substitution of alkyls in the amino group tends to diminish antiseptic action.
- (f) Practical abolition of antiseptic properties results when amino groups are acetylated or are replaced by hydroxyls.
- (g) Comparative antiseptic action on organisms of different types (*Staphylococcus aureus* and *B. coli*) shows marked irregular variation.

D. T. HARRIS. Active Hyperæmia. Communicated by Prof. W. M. Bayliss, F.R.S.

1. The lingual nerve contains true vasodilator fibres, just as the sympathetic contains vaso-constrictor fibres; both are equally independent of the intervention of metabolites.

2. No evidence was found that functional hyperæmia is due either to diminution in vaso-constrictor tone or to increase in vasodilator tone.

3. The experiments show that the increased blood-supply during muscular activity is due entirely to the products of metabolism; the absence of a simultaneous excitation of the vaso-dilator nerves during voluntary movement, though probable, is not proved.

4. Of the metabolites estimated, CO_2 and $\alpha\text{-OH}$ organic acids were found to be increased.

5. Apart from muscular activity, one function of vaso-dilator nerves was found to be concerned with the control of body temperature: active hyperæmia in the dog's tongue may be induced by reflex excitation of the vaso-dilator nerves through stimulation of heat receptors in the skin.

B. B. SARKAR. The Depressor Nerve of the Rabbit. Communicated by Sir E. Sharpey Schafer, F.R.S.

1. The depressor nerve of the rabbit

appears to be connected, at least in part, with a special collection of ganglion-cells in the vagus, distinct from the ganglion of the trunk. This collection may extend a certain distance into the superior laryngeal or may pass into the vagus trunk some distance below the ganglion of the trunk, but in most it lies in close contiguity with and just below that ganglion. The cells of the group in question probably give rise to the afferent fibres of the depressor.

The exact point of origin of the nerve is variable. It is usually formed by two branches, one from the superior laryngeal and one from the vagus. In some cases it is double throughout, in others single. It is connected below by fine branches with the inferior cervical ganglion, and can be traced to the root of the aorta and base of the heart.

2. The size of the nerve and the number of fibres it contains vary in different individuals. The left nerve is generally larger and contains more fibres than the right.

3. The depressor contains not only medium-sized myelinated fibres, but also a considerable number of very fine myelinated fibres, and others which are non-myelinated. It is, therefore, probably not wholly formed, as has usually been supposed, of afferent fibres, for these fine myelinated and non-myelinated fibres presumably belong to the autonomic nervous system and are efferent.

PROF. A. LIPSCHUTZ, M.D., B. OTTOW, M.D., C. WAGNER, and F. BORMANN. On the Hypertrophy of the Interstitial Cells in the Testicle of the Guinea Pig under different experimental Conditions. Communicated by Dr. F. H. A. Marshall, F.R.S.

In experiments with partial castration one may observe in small testicular fragments enormous hypertrophy of the interstitial tissue, the number and the size of the interstitial cells being very markedly compensatory one, as is shown by the following experimental evidence:—

A. Hypertrophy of the interstitial cells is not present in all cases of partial castration and very small testicular fragments with a not very much augmented relative number, and consequently with a highly diminished absolute number, of interstitial cells may suffice for a normal masculinisation.

B. On comparing testicular fragments supplied by blood in different ways (a frag-

ment from the upper and a fragment from the under pole of the testicle) one finds that the fragment which seems to be better supplied by blood shows more pronounced tendency to hypertrophy of interstitial cells.

C. Numerous hypertrophy of interstitial cells may take place in an upper testicular fragment, even when the other testicle is present in the body.

4) Marked hypertrophy of interstitial cells may take place when we transform both testicles into upper "fragments," by retaining the testicle near the under pole and by scattering away only a very small quantity of testicular mass.

In view of all these experiments it seems clear that hypertrophy of the interstitial cells, as observed in indifferent experimental conditions, has nothing to do with the internal secretory function of the testicle in its relation to the organism as a whole. This hypertrophy is caused by local conditions, and is not brought about in response to general compensating requirements.

ROYAL INSTITUTE. On Saturday (Mar. 4). Sir Ernest Rutherford begins a course of six lectures on Radioactivity. The Friday Evening discourse on Mar. 3 will be delivered by Dr. C. Morley Wenyon, on Microscopic Parasites and their Carriers.

THE SOCIETY OF DYERS AND COLOURISTS.

Manchester Section.—At a meeting of the Manchester Section of the Society of Dyers and Colourists, on Friday, February 17th. Prof. E. Knecht in the chair, Dr. S. Judd Lewis, R.Sc., B.Sc., F.I.C., Ph.C., read a paper entitled "The Quantitative Fluorescence of Cellulose, its Derivatives, and Certain other Substances."

The author of the paper stated that he had found that when an ultra-violet spectrum of wave lengths 3300 to 2100 (which is invisible to the naked eye) is projected on to a sheet of note paper or a piece of bleached cotton fabric, the spectrum becomes "degraded," i.e., the ultra-violet rays become converted into visible rays which can be photographed by means of an ordinary camera. It is found that under the same conditions the various papers and fabrics examined give photographic images of varying intensities according to their composition and mode of manufacture. By acetylation the cellulose its fluorescence is enormously increased while nitration depresses this constant almost to vanishing point. Different forms of cellulose had also been examined, and the results obtained were shown. The various

treatments to which cotton fabrics were submitted in bleaching as well as the degree of beating of pulp in paper manufacture all found expression in the photographic images, so that it would appear that an application of the method to the examination of industrial products might be anticipated.

THE COLLOID STATE. Dr. J. Newton Friend, head of the chemistry department of the Birmingham Municipal Technical School, completed on Friday last a course of five lectures on "The Colloid State." The lectures were designed to appeal specially to science teachers and those engaged in the paint and varnish industries. The attendances were satisfactory, and at the conclusion of the series a hearty vote of thanks was passed to the lecturer, on the motion of Mr. G. King, M.Sc., seconded by Mr. Mecock.

The syllabus of the lectures was: (1) What is a colloid? Characteristic features of the colloid state. Emulsoids and suspensoids. (2) Preparation of sols. Sizes of colloid particles. Optical properties. (3) Electrical and other properties of sols. (4) Emulsions and emulsoids. Gels. (5) Application of colloid chemistry to domestic and technical life.

The word colloid was introduced by Graham to designate substances of a gluey nature that apparently dissolve in water, yielding clear diphasic mixtures. The water is termed the continuous phase, and the glue the disperse phase. Such a system is termed a sol, and differs from a true solution in that the disperse phase will not readily diffuse through parchment or jelly. Graham regarded these gluey substances as a distinct world of matter, but it is now recognised that it is purely a question of the size of the particles of the disperse phase. If the latter is of mere molecular dimensions, an ordinary solution results; if the disperse phase consists of large particles, the mixture is termed a dispersion. Intermediate between these two extremes lies the colloid realm. For the sake of convenience, the colloid range is limited to those particles assumed spherical, whose diameter lies within the arbitrarily fixed range of 1M to 100M. Above this size they are regarded as suspensions, below as molecular solutions.

It would appear, therefore, that all substances may yet be prepared in the colloidal state, if suitable continuous phases can be obtained, and, on the other hand, it

would not appear impossible for Graham's "colloids" to be prepared in a crystalline form. Indeed, in some cases, such as gelatin and agar, this has already been achieved. It is, therefore, preferable to speak of the "colloid state" and to regard it in much the same way as the solid, liquid and gaseous states are regarded, remembering that they all gradually merge the one into the other. The systems most commonly studied are suspensoid and emulsoid, sols, consisting of solid and liquid disperse phases respectively in liquid continuous phases. Thus platinum hydrosol is a suspensoid, the continuous phase being water, whilst starch in similar circumstances yields an emulsoid. Six other systems, however, are possible. Ruby glass owes its colour to the presence of particles of solid gold of colloid size suspended in the solid glass continuous phase. The blue colour of the sky is largely attributable to a solid disperse phase disseminated throughout a gaseous continuous phase.

Dr. Friend dealt more particularly with suspensoids, emulsoids and gels. Suspensoids may be prepared either by dispersion or condensation methods—the latter being the more usual. Red and blue gold sols were prepared by the reduction of auric chloride with tannic acid, and with hydroxylamine hydrochloride respectively. The variation in colour is due to a difference in the size of the gold particles, the blue being the larger.

Attention was drawn to the retarding action of organic emulsoids upon the rates of many chemical reactions. Experiments were shown, illustrating in a striking manner the reduced corrodibility of iron, lead, zinc and aluminium in emulsoid hydrosols such as those of gelatin, glue, starch, albumin, &c. This is of considerable domestic interest, since in most culinary operations emulsoids find their way into the cooking utensils and thus preserve them from undue corrosion. The retardation was beautifully shown in the case of mercuric iodide, which is normally precipitated from the solution as a labile yellow mass, which rapidly turns red as it changes to the more stable variety. By precipitating the salt in the presence of gelatin, a canary precipitate is obtained which retains its colour unchanged for half an hour or more, according to circumstances, and only very slowly turns to the red form. These retardations

are apparently due to adsorption, and in many of the foregoing cases the requirements of the adsorption law are known to be complied with.

Some beautiful Liesegang rings were shown and mock agates produced in blocks of gelatin. Dr. Friend gave his own explanation for their formation. On addition of silver nitrate to the bichromated gelatin, colloidal silver chromate is first formed. The gelatin, however, retards the rate of precipitation of the salt for the reason already given, but diffusion continues until the colloid particles have grown too large, and they then begin to precipitate out. The distance between the rings, therefore, is the algebraic sum of the rates of diffusion and precipitation.

The lectures were fully illustrated with lantern slides, exhibits, and with experiments. The Brownian movement was shown under the ultra-microscope.

VAN DER LINGEN, J. S., AND WOOD, R. W.—The Fluorescence of Mercury Vapor. *Astrophysical Journal*, 54, 149—160, October, 1921. The University of Chicago Press, Chicago, Ill.

ABSTRACT.

The Fluorescent spectrum of mercury vapor cannot be excited in quiescent vapor, but only in vapor which is being distilled from the emetal at a temperature of 150° or more. This proves that the active molecules are not neutral monatomic molecules but others present only during distillation, perhaps diatomic molecules. The spectrum consists of three lines— λ 2536, 2539, and 2346 Å—and four structureless bands with maxima at 2346, 2540, 3300, and 4850 Å. While the complete spectrum is excited by light from a zinc spark, single lines excite only part. The relation of the spectrum to the exciting light is of great interest. The broad bands with maxima at 3300 and 4850 Å may be excited, with varying relative intensity, by λ 1854—62, 2346, or 2536—40 Å; whereas the band λ 2346—2100 Å is excited only by λ 2000—2150 Å, the position of the maximum depending on the particular wave-length used. All the effective exciting lines lie, of course, in the absorption spectrum of mercury vapor.—GORDON S. FULCHER.

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LECTURES BEFORE EASTER, 1922.
FRIDAY EVENING DISCOURSES

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford. "Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College, Prof. of Chemistry to Royal Academy. "The Pigments and Medicines of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., M.B.E., Prof. of Chemistry University of London. "Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of "Drama and Life," etc.—"Jane

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.B.E., Prof. of Natural Philosophy, E.L. "Evolution of the Elements."

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Application for permission to inspect the apparatus should be made direct to the Research Chemist at the Laboratory. (Telephone: City 181).

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3230.

INSTITUTE OF CHEMISTRY.

44TH ANNUAL GENERAL MEETING.—*Report of President's Address.*—At the 44th Annual General Meeting of the Institute of Chemistry, the President, Mr. A. Chaston Chapman, F.R.S., presented the first Meldola Medal to Dr. Christopher Kelk Ingold. The medal, which is the gift of the Society of Maccabæans, has been instituted as a memorial to Prof. Raphael Meldola, a Past-President of both the Institute and the Society, and is awarded for meritorious original work in chemistry conducted by British subjects under thirty years of age.

In the course of his presidential address, Mr. Chaston Chapman said that owing to a variety of causes—foremost among which must be placed the intensive educational effect of the great war—the importance of chemistry to the national well-being was daily becoming more widely and more clearly recognised, and with that recognition had come a great development of the work of the Institute. The Roll of Members had increased during the past twelve months by 371 to over 3,540, and the students by 94 to 983. The organisation of the profession of chemistry was thus being steadily effected. The older members had the satisfaction of seeing the Institute placed on a sure foundation, and its position as the body truly representing professional chemistry in this country, acknowledged alike by chemists, by the general public, and the Government.

Referring to the scheme recently inaugurated under arrangements made with the Board of Education for the award of National Certificates in Chemistry to students in technical schools in England and Wales, the president remarked on the advantage of bringing such students at an early age into touch with the professional qualifying body. Later, when the scheme was in operation, the Council would consider whether and to what extent the certificates should be allowed to rank towards the fulfilment of the conditions required for admission to the examination for the Associateship of the Institute.

In an open and comparatively young profession such as chemistry, it was necessary

that the public should understand clearly the nature of the work in which the members were engaged. He did not believe that any single cause had contributed so greatly to retarding in the past the progress of the profession of chemistry in this country as the misapplication of the word *chemist*. In no other country was there any confusion between the person who practised chemistry and the person who followed the profession of pharmacy, and Continental chemists often expressed their inability to understand what they no doubt regarded as one of our many national peculiarities. For the present, the members had to be content to express the hope that their friends the pharmacists, without relinquishing their rights, would, wherever possible, refer to their ancient, important, and very honourable calling by the word which more accurately defined and described it. The power—he might say the tyranny—of a word was often very great, and he appealed to the Press, as a very important factor in the enlightenment of the general public, to assist, so far as it could, by employing the terms *chemist* and *pharmacist* respectively in the correct signification. It was to be deplored when such confusion was the unfortunate consequence of the poverty of a language; but, in this instance, the correct and distinctive words were readily available, and the confusion was therefore easily avoidable. If chemists themselves used the word without qualifying adjectives, it would be an effective stop towards establishing the proper meaning of the word.

The war had proved a very powerful factor in informing the public of the activities of the chemical profession, which occupied a position in the public esteem such as he (the president) would not have thought possible in his own life time; but every member should help to the best of his ability to consolidate the position they had gained and to keep alive in the public mind the enormous national importance of the profession. Whether we regarded chemistry as a subject of study, essential to an understanding of the world in which we lived, as an agent which had done so much to transform the life of man, as one of the most powerful factors in the creation of material wealth, or, finally as that department of natural knowledge on which our national prosperity and our national security so largely depended, its supreme importance was equally manifest.

Commenting on the production of British laboratory apparatus, porcelain and fine chemicals, the president said that the views taken by the Council of the Institute, and by many others who were desirous of seeing these industries firmly established in this country, was that it would be a mistake of the first magnitude to revert to the position of dependence on foreign and possibly enemy nations. The whole chemical industry (including those essential to successful conduct of war), the prosecution of scientific research, with all that implies, and the gradual teaching of science in schools and universities, all depended upon a supply of laboratory apparatus, porcelain and chemicals, adequate in quantity, suitable in quality, and reasonable in price. On national grounds, it was obviously desirable that the country should be ever directing its activities to production and to the increasing development of its internal resources. There was, moreover, the further consideration, which was much in the minds of the Council, that the establishment of these essentially chemical industries demanded the services of properly qualified chemists. The British manufacturers had made great progress under difficult circumstances, and there appeared to be no good reason why we should not be self-supporting in all the requirements of the profession.

After complimenting the Local Sections of the Institute on their activity and acknowledging the help they had given to the Council in connection with the work of the Institute, the President commented on the fact that, at a time of almost unparalleled industrial depression, less than two per cent. of the members were without employment. He thought they might draw from this the comforting inference that employers were looking more and more to science to help them in overcoming technical difficulties and in improving their manufacturing operations. He concluded his address, however, with a note of warning. Many parents still retained the impression that chemistry afforded a rapid road, if not to wealth, at least to a comfortable competence, and that it involved a less expensive course of preparation than for other professions. A keen love of the subject was essential to success; but those who were attracted to chemistry should be prepared to face a great deal of hard and often unattractive work, and to make the very real sacrifice which a professional career inevitably involved. The course of training of the average chemical student was of a university character, and made the

same demands upon the financial resources of parents as that for medicine and law.

The present position of the profession should inspire its members with feelings of pride and deep satisfaction, and should stimulate them to increased endeavours to raise it still higher towards that position of pre-eminence which it was surely destined to occupy.

There was scarcely a department of human activity which was not influenced more or less profoundly by the discoveries and developments of chemistry, nor was there a single individual in the community whose comfort had not been increased and whose daily life had not been made happier—or at least, more tolerable—through the beneficent operations of that science. What discoveries in chemistry the future might hold, and in what way those discoveries might still further modify the material life of man, none could say, but it was not unlikely that if any distinctive term should be applied by the historian of the future to the era on which we were now entering, he would describe it as the "Age of Chemistry."

THE ATOMIC THEORY IN 1921.

(Continued from Last Week.)

Presidential Address, Section B., S. African Association for the Advancement of Science, Durban, by James Moir, M.A., D.Sc., F.R.S.S.A., F.I.C., F.C.S.,

When we come to the next member rubidium we find that the atomic weight is no longer twice the atomic number plus one, as it is in the case of lithium, sodium, and potassium. Rubidium ion Rb is 18Θ ($48H + 48e$) $37H + 18\Theta$, in which the nucleus contains 10 more hydrons and electrons than would have been expected from the lower members: the nuclear charge is 37, and there are 36 external electrons, arranged counting from the inside as before, as 2, 8, 8, 18. Irving Langmuir (J. Amer. C.S., 1919, 879) suggests that the external 18 are arranged not like the internal 18 (viz., as 2, 8, 8), but by uniform distribution over a spherical surface, viz., two polar and 8 in each of two zones round the equator. This again gives a surface without projections or lacunæ, and corresponds to the inertness of the rubidium ion. Similarly Cs (cesium ion) is 27Θ ($78H + 78e$) $55H + 27\Theta$, with weight 133, nuclear charge 55, and 54 external electrons arranged 2, 8, 8, 8, 18, 18. The top member, which is unknown "ekacæsium" (it lies between niton and radium) would have the structure 43Θ ($136H$ $136e$ $87H$) 43Θ

with external electrons arranged 2, 8, 8, 18, 18, 32. This arrangement of the electrons in concentric layers finds its origin in Rydberg's remarkable observation that the atomic numbers of helium, neon, argon, krypton, xenon and niton (viz., 2, 10, 18, 36, 54 and 86), which are also the numbers of external electrons in the ions of lithium, sodium, potassium, rubidium, caesium and ekacæsium, are given by the mathematical formula $N = 2(1^2 + 2^2 + 3^2 + 4^2 + \dots)$ &c.), e.g., $36 = 2(1^2 + 2^2 + 3^2 + 4^2)$ for the fourth member. This at once gives the distribution in the concentric shells as 2, 8, 8, 18, 18, 32. Langmuir gives this a physical basis by noting that areas of concentric spheres of radius 1, 2, 3, 4, 5 vary in the same proportion as the numbers 2, 8, 18, 32, 50. He therefore assumes that these higher atoms have spheres of radius 1, 2, 3 and 4, and that there are two electrons in each unit of area in every sphere except the innermost, thus giving the numbers 2, 8, 8, 18, 18, 32, 32, it being assumed that each area-unit is filled *twice* over with a *single* electron, giving thus 2, 2+8, 2+8+8, 2+8+8+18, and so on, these being the numbers 2, 10, 18, 36, 54, &c., which are the total number of electrons present. This theory is so beautiful and comprehensive that it must be essentially true: at any rate it is likely to supplant the older theory that the electrons are in revolution round the nucleus like planets round a sun. Bohr has, however, recently suggested that 32 is succeeded by 18 and 8, not by 50.

The same theory, it may be noted, applies to the halogens fluorine, chlorine, bromine, and iodine. Fluoride ion F' is $5\Theta(10H+10\Theta\ 9H)+5\Theta$, which is an "inert" structure like that of sodium ion and that of neon ($=5\Theta(10H+10\Theta\ 10H)+5\Theta$). So the chloride ion is $9\Theta(18H+18\Theta\ 17H)+9\Theta$ when its atomic weight is 35, $17H+9\Theta$ when its atomic weight is 35. When the atomic weight is 37* the constitution is $9\Theta(20\ 20\Theta\ 17H)+9\Theta$. Similarly argon of the atomic weight 40 (i.e., out of order in the periodic table) is $9\Theta(22H+22\Theta\ 18H)+9\Theta$. Bromine ion is $18\Theta(45H+45\Theta\ 35H)+18\Theta$, krypton being $18\Theta(47H+22\Theta\ 18H)+9\Theta$, bromine ion is $18\Theta(45H+45\Theta\ 35H)+18\Theta$, krypton being $18\Theta(47H+47\Theta\ 36H)+18\Theta$, iodine ion is

* See Aston, *Phil. Mag.*, 1920, 611, and my prediction. "Modern Alchemy and Transmutation," J. S. A. Association Anal. Chemists, 18/9/17.

$27\Theta(74H+74\Theta\ 53H)+27\Theta$, xenon being $27\Theta(76H+76\Theta\ 54H)+27\Theta$. The theory is, however, rather unsatisfactory for carbon and all the elements below it. Carbon would be $\Theta(6H+6\Theta\ 6H)+\Theta$ with a residual valency of plus 4, but, as I say later on, it is likely that the nucleus itself is arranged like a tetrahedron (as the valencies are), whereas the above is unsymmetrical. Similarly, helium gas would be $\Theta(2H\ 2\Theta\ 2H)\Theta$, which is very unsatisfactory from its lack of symmetry. Helium gas has in reality a round molecule, as shown by its $^\circ p/^\circ v$ ratio.

Again, if Rydberg's formula be examined surprise will be felt that it does not read $N=2(1^2+1^2+2^2+2^2+3^2+3^2+4^2, \dots)$, in which case it would be perfectly symmetrical. Assuming then, this form of the equation, the successive sums are 2, 4, 12, 20, 38, 56, 88, these being therefore the number of electrons. Helium would be *second* in this series, and have a shell of 4 electrons instead of 2. As it is neutral, one would have to assume a nucleus of $4H$, with the shell of 4 electrons far out and in tetrahedral order. The nuclear charge, the number of external electrons, and the atomic number would all be the same, viz.: 4, if two elements exist between hydrogen and helium. This very neat and satisfactory proposition is, however, knocked on the head by the existence of the α -particle of radioactivity which has mass 4 and two positive charges. It changes into helium on striking any kind of matter, and is therefore regarded as helium nucleus. The only explanation of these contradictions that suggests itself to me is that of rearrangement. Helium nucleus with atomic number 2 is unsymmetrical, viz. $(2H+2\Theta\ 2H+)$ (see Fig. 7), but when two electrons are taken on to give helium gas, the arrangement $\Theta(2H\ 2\Theta\ 2H)\Theta$ changes into the conformation shown in Fig. 8.

Although there is experimental evidence regarding the nucleus in this case, there is none in the case of any of the others. Carbon nucleus as $(12H++6\Theta)$ is merely a deduction from helium nucleus $(4H++2\Theta)$. If the atomic number of carbon is 8, not 6, the nucleus is $(12H++4\Theta)$ which can be constructed as a tetrahedral model, whereas $(12H++6\Theta)$ cannot. In addition the four electrons which would then be required to make a kernel out of a nucleus could also

be arranged tetrahedrally, and finally the remaining four valency electrons would form an outer tetrahedron.

At this stage a brief *resumé* of the experimental evidence for the present-day view of the atom is necessary. The essential conception, as I have mentioned in the introduction, is that the atom is hollow consisting of a sphere, or concentric spheres, of electrons with an outer diameter of about 10^{-10} cm., and an exceedingly small nucleus (about $\frac{1}{1000}$

electron sphere), which, however, contains nearly all the weight of the atom, and in the case of a heavy element a very high positive electric charge. Just outside this nucleus there is an immensely powerful electric field, due to the action of the positive nucleus and the sphere or spheres of electrons. This conception, which is due to Sir E. Rutherford, arose in order to explain the fact that the α -particles of radium, which are about 7,000 times as massive as electrons, and which are positively charged and travel with a speed of about 50,000 miles a second, when passed through thin metallic sheets, are deviated through large angles just as the tiny electrons can be deviated by moderate electric fields. The highly-deviated particles are those which have not only penetrated the electron-sphere of the atom, but have passed uncommonly near to the nucleus, and have thus been thrown into a hyperbolic orbit despite their immense velocity. It is conceived also that those which actually aim at the nucleus of a larger atom are turned back in their path.

This conception holds in its simplest form for the first 20 (or so) elements which have only one sphere of electrons. For the higher elements it is necessary to assume two or three concentric spheres of electrons and a bigger and more highly charged nucleus, until at the top of the series the nucleus becomes unstable owing to its excessive charge, and disintegrates automatically, giving rise to radioactivity. Since atoms are electrically neutral, the total number of external electrons in the spheres must be equal to the positive charge of the nucleus. The number of external electrons can be estimated experimentally from the scattering of X-rays, because each electron is, comparatively speaking, far apart from its neighbours, and thus acts as an independent agent. Barkla thus found by trying

different elements that the number of electrons is always a little less than half the atomic weight of the scattering element. Again, calculation from the deviation of α particles (mentioned just above) when they are passed through different metals, leads to a result for the positive charge of the nucleus amounting to the electrical unit multiplied by about half the atomic weight of the element used as a screen. These two experimental lines thus converge to the same result. Again in 1913, Moseley* a young genius who was killed in the war, applied the principle of the X-ray spectrum, which has proved very fruitful in the case of salt crystals, to the lower elements, and discovered the remarkable law, $N = K\lambda^{-1/2}$, in which λ is the wavelength of the chief X-ray line given by an element, and N is a number which is a natural integer, going up by 1 as the element investigated goes up the periodic table. N is, in fact, an "atomic number," which depends only on the place of the element in the Periodic Table. Curiously enough, when the results are plotted, the bottom of the series is found at helium, not at hydrogen, so that N is not the Chemist's atomic number, but one less. It is seen at once that N is also about half the atomic weight, so that three *lines of evidence converge* to prove that the nuclear positive charge (and in consequence the number of external electrons) are determined in the case of each element by its position in the Periodic System, and are numerically identical with the "atomic number" as defined above.

The Periodic Table is thus explained away (except for its arrangement in 8 or 10 columns), since, for example, sodium metal has 11 plus charges in its nucleus and 11 electrons outside, and the next element (magnesium) has 12 of each, thus putting up its "valency" by one. Valency is, of course, as mentioned on page 1, the criterion of chemical properties, which have nothing to do directly with the nucleus of the atoms, but are solely conditioned by the external electrons, and, to speak more particularly, are almost solely conditioned by the number and arrangement of the few outermost electrons which are left over from filling the atom with a spherical shell. As already indicated on page 4, sodium is monovalent and aluminium trivalent; be-

* *Phil. Mag.*, 1913, 1,024, and 1914, 703.

cause the completed shell* of all the elements N, O, F, Ne, Na, Mg, Al contains 10 electrons, leaving respectively 1 and 3 over for valency electrons. Similarly the negative valencies 1, 2, and 3 of fluorine, oxygen and nitrogen are due to their possessing respectively 9, 8, and 7 external electrons, whereas 10 are required to make an inactive shell, of the same shape as that of neon. The latter is inactive because it has 10 external electrons exactly (being the 10th element in the Periodic Table), and therefore none over or under the number required for a complete shell. The analogous cases amongst the higher elements will be discussed later on.

(To be continued.)

* The "completed shell" is, it may be repeated, the ionised form of the element.

PROCEEDINGS AND NOTICES OF SOCIETIES.

Provisional Report.

THE ROYAL SOCIETY.—*Ordinary Meeting, February 23, 1922, Sir Charles Sherrington, President, in the Chair.*—The following papers were read (*the Summaries here printed having been supplied by the authors for use at the Meeting*):—

C. D. ELLIS.— *β -Ray Spectra and their Meaning.* Communicated by Sir E. Rutherford, F.R.S.

A method is given for finding wave-lengths of γ -rays, which are of too high a frequency to be measured by the crystal method. This depends on the fact that γ -rays are converted into β -rays according to the quantum relation. If the energies of the groups of electrons ejected from a substance by γ -rays be measured, it is only necessary to add to these energies the work done in removing the electron from inside the atom to the surface to obtain $h\nu$. The value of this additional term may be found from observations of the energies of corresponding groups excited in different substances. This method is applied to find the wave-lengths of the γ -rays emitted by radium B, radium C, and thorium D. The radium B, radium C, and thorium D. The energies of the β -ray groups of thorium D have been measured for this purpose. It is shown that these γ -rays are emitted from the nucleus and the numerical values of the wave-lengths suggest very strongly that the

quantum dynamics applies to the nucleus, and that part, at least, of the structure can be expressed in terms of stationary states. Suggestions for the energy of these stationary states in the radium B and thorium D nuclei are given.

PROF. A. E. CONRADY.—*A Study of the Balance.* Communicated by Mr. C. V. Boys, F.R.S.

1.—The first weighings by the Gaussian method of exchange made with an inexpensive analytical balance, stated to be sensitive to 1/5th mg., gave a probable error of only 0.004 mg., and led to a prolonged investigation with a view to reducing this error. Persistent failure eventually led to the discovery of a constructional fault in the suspensions. On removing this, the probable error fell to 0.0013 mg. Discussion of residual errors of the series of weighings which gave this result disclosed a new systematic error, depending on the sequence of pointer readings in successive exchanges, which was attributed to imperfect elasticity and irregular curvature of knife-edges.

A method of double exchange of loads was then evolved which, by close adjustment of a light rider, caused all readings to fall on two alternating positions of rest, and eliminated the suspected source of error. The probable error fell to 0.0008 mg., and seemed now largely due to irregular air-currents. Arrangements allowing manipulation of loads without opening of balance case then reduced the probable error to an average value of 0.0004 mg., which is $\frac{1}{2}$ to 1/5th that recorded for similar weighings by the great institutions for weights and measures.

2.—The principal conditions which a balance of highest precision should satisfy are deduced from a quantitative estimate of sources of error.

3.—Considerable importance is attributed to the "autostatic" state of a balance; if the centre of gravity of the moving parts falls in the supporting line of the central knife-edge, the reading of the pointer becomes independent of levelling of the balance case, and highly accurate results can be obtained on very infirm supports.

J. S. OWENS, M.D.—*Suspended Impurity in the Air.* Communicated by Sir Napier Shaw, F.R.S.

The paper describes an investigation, the object of which was to provide some simple and effective method for examining the quantity and nature of dust in the air and

its relation to visibility, for examination of industrial fumes, dust in mines, smoke fogs and the like. The work was carried out by the author for the Advisory Committee on Atmospheric Pollution.

A short description and criticism is given of methods now in use for the same purpose, and of the author's automatic filter and results obtained therefrom.

A new method of sampling for measurement and examination is described, in which a fine jet of air is made to strike a glass surface with high velocity, depositing the dust thereon. The evolution of the instrument is described and the final form which it has taken. Tests of efficiency are given, and also experiments showing the effect of velocity of jet on the operation of the instrument.

The adhesion of dust to the glass is discussed and a short description of possible applications given. As illustrating one application experiments are described which indicate—

(a) That visibility is usually a function of amount of suspended impurity.

(b) That suspended dust travels over great distances; records being described of dust which presumably must have come from the Continent.

(c) That the microscopical examination of such dust records indicates curious differences depending upon wind direction, which are at present not explained.

A table of experiments made at Holme, Norfolk, is given, and these experiments discussed.

W. V. SOUTHWELL.—On the Free Transverse Vibrations of a Uniform Circular Disc clamped at its Centre; and on the Effects of Rotation. Communicated by Prof. H. Lamb, F.R.S.

A recent paper by Prof. H. Lamb and the present author dealt with the influence of rotation upon the normal modes and frequencies of free transverse vibration in a uniform circular disc, complete freedom from constraint being assumed. Some of the modes were found to involve transverse displacement of the centre, and to make the analysis more representative of the conditions which obtain in the vibrations of turbine discs the present paper extends it to cover the effects of constraints which prevent, along a small circle concentric with the free edge, the occurrence either of finite transverse displacement w , or of finite slope

$\delta w / \delta r$. The constraints are assumed to have no effect upon the centrifugal stress-system.

Section I. deals with a disc which does not rotate. Clamping along a small circle is found to produce only slight changes of frequency in modes characterised by two or more nodal diameters, but to be important in its effect on the "symmetrical" modes (no nodal diameters) and on modes having one nodal diameter, although in the latter case these effects tend to a zero limit as the radius of clamping is indefinitely reduced.

Section II. deals with the other extreme case, in which the flexural rigidity may be neglected. Here the central constraint, whatever be the radius of clamping, is found to have no effect upon the natural frequencies.

Section III. deals with the general case, in which both flexural and centrifugal stresses require to be considered. The gravest frequencies in modes which have nodal diameters may be calculated by the formula previously given; a special investigation is made of the gravest frequency in a symmetrical mode.

A. E. OXLEY, M.A., D.Sc.—Magnetism and Atomic Structure, II.—The Constitution of the Hydrogen-Palladium System and other Similar Systems. Communicated by Prof. A. W. Porter, F.R.S.

The susceptibility of palladium black charged with hydrogen is found to be less than that of pure palladium black. From this it is concluded that the occluded hydrogen is neither in the atomic state nor condensed molecular hydrogen. The results agree with the existence of a chemical compound, probably Pd-H. The nature of this combination is discussed along lines similar to those developed for the H-H system (Proc. Roy. Soc., A., Vol. 98, 1921).

In the hydrogen molecule, each atom, on this view, thrusts its electron into the other atom, the bond being represented by a pair of electrons held in common. The palladium atom has 46 electrons, the hydrogen atom 1 electron, the latter being thrust into the outer shell of the palladium atom. If these 47 electrons take up a configuration like that of the silver atom (atomic number 47), which is diamagnetic, the fall of susceptibility may be accounted for.

Paramagnetic manganese fused in hydrogen becomes ferro-magnetic. It is suggested that the occluded hydrogen atoms thrust their electrons into the outer shells

of the manganese atoms, producing in them electron configurations analogous to that of the iron atom. The amount of occluded hydrogen necessary to produce the effect observed is calculated.

The cubical atom theory appears to be consistent with these conclusions, in so far as the properties of such compound systems are determined by the sharing of electrons.

T. CARLEMAN and PROF. G. H. HARDY. F.R.S.—Fourier's Series and Analytic Functions.

If $f(\lambda)$ is integrable in the interval $0, 2\pi$, and the associated function $\phi(u) = \frac{1}{2}[f(a+u) + f(a-u)]$, where $0 < u < 2\pi$, is harmonic and bounded in a certain neighbourhood of $u=0$, then the necessary and sufficient condition for the convergence of the Fourier series of $f(\lambda)$, at $\lambda=a$, is that $\phi(u)$ should tend to a limit when u tends to zero through positive values.

PROF. A. McAULAY.—Multenions and Differential Invariants, II. and III. Communicated by Mr. W. B. Hardy, Sec. R.S.

Part II. is a continuation of a previous communication with the same title. The fundamental quadratic form is introduced. It is shown how all multienion formulæ may be put into invariant form. Detailed rules are developed for this purpose. Tests, both by finite and by infinitesimal transformation are given, for ascertaining whether invariance of each one of six types subsists for any given function. Riemann's and Weyl's manifolds are studied, and a detailed analysis of the general conception of curvature in the latter is given. Finally, multienion methods are compared with those of the Theory of Tensors and details furnished for translating from one mode of presentation to the other. The special applications to the case of $n=4$ and relativity have not yet been reached.

Part III. gives a rapid general survey of the applications of a Riemann manifold to relativity. In relation to matter and gravitation no new principle is introduced, but the electro-magnetic field is treated in a novel manner. The scalar and vector potentials are wholly ignored, and the subject seems to gain in clearness thereby. The application to matter in bulk is kept in mind, and it is considered imperatively necessary to adapt relativity methods to a sufficiently general set of relations as at least to leave Maxwell's explanation of crystalline reflection, refraction and transmission of light intact. The paper reaches a satisfactory point of view of these aspects.

THE CHEMICAL SOCIETY.—*Ordinary Scientific Meeting, Thursday, March 2nd, 1922, at 8 p.m.*—The following papers were read:

New halogen derivatives of camphor, Part II.— α' -bromocamphor. T. M. Lowry, V. Steele, and H. Burgess.

The rotatory dispersive power of organic compounds, Part X.—The preparation and properties of pure ethyl tartrate. T. M. Lowry and J. O. Cutter.

The molecular configuration of polynuclear aromatic compounds, Part I.—The resolution of γ -6:6'-dinitro- and 4:6:4':6'-tetranitro-diphenic acids into optically active components. G. H. Christie and J. Kenner.

THE OPTICAL SOCIETY.—*Imperial College of Science and Technology, South Kensington, S.W.7.*—List of Officers and Council for 1922-23, appointed at the Annual General Meeting, held on 9th February, 1922:—

President: Sir Frank Dyson, M.A., LL.D., F.R.S., Royal Observatory, Greenwich, S.E.10.

Vice-Presidents: Prof. F. J. Cheshire, C.B.E., Imperial College South Kensington; T. Smith, B.A., National Physical Laboratory, Teddington; R. S. Whipple, 15, Creighton Avenue, Muswell Hill, N.W.10.

Treasurer: Major E. O. Henrieci, R.E., 29, Royal Crescent, W.11.

Secretaries: (a) Business Secretary, Prof. Alan Pollard, Imperial College, South Kensington; (b) Papers Secretary, F. F. S. Bryson, M.B.E., M.A., B.Sc., Glass Research Association, 50, Bedford Square, W.C.1.

Librarian: J. H. Sutcliffe, M.B.E., 10, Cligord's Inn, Fleet Street, E.C.4.

Editor of Transactions: J. S. Anderson, M.A., B.Sc., Ph.D., 5, Udney Park, Teddington.

Council: J. S. Anderson, M.A., B.Sc., Ph.D., 5, Udney Park, Teddington; Instr.-Comdr. T. Y. Baker, R.N., B.A., Admiralty Research Laboratory, Teddington; L. Booth, M.A., "Delamere," Sandal, near Wakefield, Yorks.; R. W. Cheshire, B.A., 23, Carson Road, Dulwich; R. S. Clay, B.A., D.Sc., Northern Polytechnic Institute, Holloway Road, N.; J. W. French, D.Sc., Friars Crag, 20, Kirklee Road, Glasgow; W. Gamble, 109, Farringdon Road, E.C.1; Mrs. C. H. Griffiths, M.Sc., 48, Alexander Road, Wimbledon, S.W.; J. Guild, A.R.C.S., Ladbagh, Park Road, Teddington; L. C. Martin, B.Sc., A.R.C.S.,

10, Latham Road, S.E.19. R. Mullineux Walmsley, D.Sc., Northampton Polytechnic Institute, Clerkenwell, E.C.1; Prof. A. W. Porter, D.Sc., F.R.S., University College, Gower Street, W.C.1; J. Rheinberg, 23, The Avenue, Brondesbury Park, N.W.; A. Whitwell, M.A., 52, Alexandra Road, Wimbledon, S.W.19.

Professor A. A. Micholien, of the University of Chicago, and Dr. M. von Rohr, of Müssers, Carl Zeiss, Jena, were elected Honorary Fellows.

SOCIETY OF GLASS TECHNOLOGY.—The fiftieth meeting of the Society of Glass Technology was held in the College of Technology, Manchester, on February 15th, the President, Dr. M. W. Travers, F.R.S., being in the chair.

In directing the attention of members to the fact that the Society was meeting for the fiftieth time, the president said that from small beginnings at the end of 1916 the Society had steadily increased its activities and membership. The number of members now exceeded 650, drawn from various parts of the world, about one hundred being American. He hoped that when the Society celebrated its one hundredth meeting it would be able to report a continued increase in its usefulness and prosperity.

The first part of the programme at the meeting was devoted to a consideration of a paper by Mr. F. W. Hodkin, B.Sc., and Prof. W. E. S. Turner, D.Sc., entitled "The Relative Advantages and Disadvantages of Limestone, Burnt Lime, and Slaked Lime as Constituents of Common Glass Batches containing soda-ash and salt cake," Part II.

In presenting this paper, Prof. Turner said it was the continuation of a paper given at a former meeting of the Society. The conclusions were that the rates of melting depended upon a number of conditions, such as the form of alkali and lime used, and the relative amounts of lime and soda used. In the case of glass such as that used for bottles made on automatic machines, and containing about 8 per cent. of lime, the soda-ash burnt lime batch appeared to be the most readily melted. With lime containing glasses, the melting could be assisted considerably by the addition of small amounts of other oxides, particularly by the addition of magnesia. In the case of glasses containing about 12 per cent. of lime, the slaked lime containing batches, in general, melted most readily. A discus-

sion followed the paper, to which there contributed Messrs. W. J. Rees, G. Simpson, A. S. Giles, and F. G. Clark. Mr. Hodkin and Prof. Turner replied.

The remainder of the meeting was taken up with a discussion of the subject of "The Melting of Glass." A number of questions on the subject had been submitted by members, and formed the basis of the discussion; this being continued from the Leeds meeting in November, 1921, at the general request of members.

The questions discussed were:—

What is the objection to using a large quantity of cullet? What are the troubles it is likely to cause? If there are any, then what is the safe maximum proportion of cullet to batch?

What is the procedure to adopt in order to ascertain the homogeneity of the glass, and

(a) is it better to fill into the furnace batch and cullet separately, or batch and cullet mixed?

(b) is it better to fill into the furnace batch and cullet by the use of a crane-filling shovel through the charging door and distribute them over as great an area as possible, or through the doghouse filled by the overhead batch hopper?

For a window glass averaging 73 per cent. silica, 14 per cent. lime, 13 per cent. soda, are there different physical properties, viscosities, difficulties in handworking, due to the nature of batch, either soda-ash or salt-cake? Should window glass made with soda-ash be inferior to window glass made with salt-cake, or less workable in glass gathering? It would seem apparent that the use of soda-ash as constituent of the batch is more efficient as to the life of the tank blocks, and also to the clouding of the window glass cylinders reheated in the furnace flame containing sulphur from salt-cake, and consequently worthy of commendation?

How long prior to working should a melt be maintained at "plaining" temperature once it is already plain?

Those contributing to the discussion were: The President, Messrs. W. R. Barker, J. H. Bickerton, Wm. Butterworth, F. G. Clark, J. Connolly, A. S. Giles, P. Haller, F. W. Hodkin, G. Simpson, V. H. Stott, Prof. W. E. S. Turner and Duncan Webb, Jun.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.—*Ordinary Meeting, 1st March, 1922.*—Held at the Chemical Society's Rooms, Burlington House, Mr. P. A. Ellis Richards, President, in the Chair. Papers, of which the following are abstracts, were read:—

Abstract.

"The Theobromine content of Cocoa Beans and Cocoa," by Raymond V. Wadsworth.

The analyses of Cocoa Beans from 21 different producing areas showed a variation in the theobromine content of the nib from 2.2 per cent. to 3.9 per cent. calculated on the dry fat-free material. The variation is due, firstly to the variety of the bean, the Criollo bean containing much less theobromine than the Foresterio, secondly to the amount of fermentation the bean has been subjected to (fermentation reduces the theobromine considerably).

In the shell, the theobromine varies much more than in the nib. The variation found was between 0.19 per cent. and 2.89 per cent. This difference is wholly due to fermentation; during the process the alkaloid is brought by the sweatings from the nib to the shell, the amount naturally present in the shell being only 0.19 per cent.

During roasting there is practically no loss of theobromine from either nib or shell.

The analyses of 22 brands of commercial cocoas showed a variation in the theobromine content of 2.39 per cent. to 3.55 per cent. calculated on the dry fat-free cocoa.

Abstract.

"The Value of Fish Scales as a Means of Identification of the Fish used in Manufactured Products," by R. E. Essery, B.Sc., A.I.C.

The author points out that, in many cases, useful information as to the variety of fish employed in manufacture may be obtained from a microscopical study of the scales. Even in the case of fish-pastes, where the scales are largely broken up, the method possesses value. The author showed diagrams of seven types of scale.

Abstract.

"The Examination of B.B. Ointments," by Norman Evers, B.Sc., F.I.C., G. D. Elsdon, B.Sc., F.I.C.

Methods of analysis are given for the

examination of certain B.P. Ointments. The Refractive Index as a method of testing ointments is discussed.

Abstract.

"The Determination of Aldehydes and Ketones by means of Hydroxylamine," by Alex. H. Bennett and F. K. Donovan.

The authors show that the method for the estimation of Citral in Lemon oil, previously described by one of them (Bennett, Analyst, 1909, 34, 14) is applicable in the case of other aldehydes, such as formaldehyde, benzaldehyde, cinnamic aldehydes, citronellal; and of ketones, such as acetone and carvone. With camphor no quantitative results could be obtained.

Slight modifications in methods of analysis which are necessary with different substances are described.

In the case of acetone, accurate results can be obtained even in the presence of ethyl alcohol. The authors consider that the estimation of citral by means of hydroxylamine is to be preferred to the method involving absorption with sodium sulphate.

THE ROYAL INSTITUTION OF GREAT BRITAIN.

21, Albemarle Street, W.1.

LECTURES BEFORE EASTER, 1922.
FRIDAY EVENING DISCOURSES

March 10.—Thomas R. Merton, D.Sc., F.R.S., Prof. of Spectroscopy, University of Oxford.—"Problems in the Variability of Spectra."

March 17.—A. P. Laurie, M.A., D.Sc., Prin. Heriot Watt College; Prof. of Chemistry to Royal Academy.—"The Pigments and Mediums of the Old Masters."

March 24.—F. G. Donnan, C.B.E., D.Sc., M.R.I., Prof. of Chemistry University of London.—"Auxiliary International Languages."

March 31.—Arthur B. Walkley, B.A., Author of "Drama and Life," etc.—"Jane

April 7.—Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.L.I., Prof. of Natural Philosophy, R.I.—"Evolution of the Elements."

CHEMICAL NOTICES FROM FOREIGN SOURCES

VARIATION OF THE MECHANICAL PROPERTIES OF ALLOYS AND METALS AT LOW TEMPERATURES.—*Leon Goulet and Jean Couanal.*

The authors have carried out a series of experiments to determine the influence of low temperatures upon the hardness and resistance of metals and alloys. The temperatures were 20° (room temperature),

20° (ice and calcium chloride), 80° (carbon dioxide snow), 100° (liquid air). The specimens were kept at the constant temperature before being tested. The results obtained showed that in general the hardness of the metal is increased by cooling. Fragility at low temperatures is a characteristic of ferrite, the rapidity of the fall of the resistance as a function of the temperature being greater the greater the proportion of ferrite present. Nickel and copper, on the contrary, do not increase the fragility while aluminium in large quantities seems to produce a slight increase of resilience. Special perlite nickel steels are very fragile in liquid air, but an increase in the amount of nickel present decreases the lowering of the fragility with the temperature. (*Comptes Rendus CLXXIV.*, 1922, No. 6.)

THE OXIDES OF URANIUM.—*P. LeBeau.*—Although much work has been done on the oxides of uranium, there is still a good deal of uncertainty as to the nature of some of them. The author in this paper summarises the work he has done on the subject. Uranium anhydride UO_3 can be obtained in the pure state by heating uranyl nitrate or uranic hydrate to constant weight to a temperature of 500° in a current of oxygen. When uranic anhydride is heated in air, it is unaltered up to 600°. Decomposition begins at 700°, and is rapid at 800°, when a greyish black powder is obtained, having the composition represented by the formula U_3O_8 . There is no further change of weight when it is heated to 1,000°, whether it is cooled quickly or slowly. At temperatures below a red heat mixtures or more probably solid solutions of UO_3 and U_3O_8 are obtained. As the atomic weight of uranium is high, these oxides have very nearly the same percentage composition, but they behave differently towards various reagents. Thus they alter slowly in contact with damp air, and at the ordinary temperature uranic anhydride is hydrated, giving hydrated uranic

acid $\text{UO}_2(\text{OH})_2 \cdot \text{H}_2\text{O}$. When organic salts of uranyl are calcined, dark greenish black oxides are obtained, which in course of time become lighter green owing to the formation of efflorescences on their surface. These oxides probably contain variable quantities of uranic anhydride, which undergoes a change when exposed to moist air. The reduction of U_3O_8 by means of hydrogen begins at about 500°, but is not complete at that temperature, even after hours of heating. If, however, the temperature is raised to 900° to 1,000° it rapidly becomes total. No intermediate oxide appears to be formed, the brown product being UO_2 . This oxide has been variously described as being black, copper coloured, or cinnamon brown, but as a matter of fact, when pure, it is always chestnut brown in colour.—(*Comptes Rendus, CLXXIV.*, 1922, No. 6.)

ACTION OF SELENIUM ON GOLD.—*H. Pélabon.*—When gold which has been polished and then exposed to the action of selenium at a temperature approaching the boiling point of the latter is examined micrographically, there is clear evidence that the gold is attacked, and after such treatment it appears to fuse more easily. It dissolves in the selenium in very small quantities, or possibly the two elements form an unstable compound. On cooling, the metal is precipitated in tetrahedric crystals.

SOME NEW DERIVATIVES OF SULPHOBENZIDE.—*Eng. Grandmougin.*—The author has prepared many derivatives of sulphobenzide such as the dihalogen compounds, the dinitro compound, etc., and finds that from the point of view of synthetic dyes they possess no advantages over those obtained from more conveniently obtained and cheaper bases. If it were possible to prepare a hexanitro compound by direct nitration, it might be valuable as an explosive, but by this means only a tetra nitro derivative can be prepared.

COMPOSITION OF ESSENCE OF TURPENTINE FROM ALEPPO.—*Georges Dupont.*—The composition of the essence of turpentine obtained from various different kinds of trees does not depend upon the nature of the tree, nor upon the time at which the essence is obtained. The composition of fresh essence obtained from Aleppo is as follows:—

d-Pinene	95 %
Inactive Borneol Acetate	1.14 %
Sesquiterpene	3.8 %

GENERAL NOTES.

DYESTUFFS IMPORTATION.—A number of questions were put in the House of Commons this week with regard to the importation of dyestuffs. Mr. Kiley asked the President of the Board of Trade whether he had approved of the action of the Dyestuff Advisory Licensing Committee in demanding from applicants for licences to import dyes highly confidential business information, such as the name of the foreign manufacturer, the purpose for which the dyes were required, and the name and address of the applicant's customer in this country; and whether the rules for the administration of the Dyes Act could be revised so as not to compel applicants to disclose confidential information to business rivals who are members of the committee?

Mr. Balfour replied that he was aware that the Dyestuffs Advisory Licensing Committee had thought it advisable, for the efficient discharge of their duties, to ask for information of the kind indicated by applicants for licences. He saw no reason for interfering with the exercise of their discretion in this matter, which, so far as he was aware, had not been a cause of complaint by users. With regard to the second part of the question, he would refer the hon. member to the provisions of Section 2, sub-section (5) of the Dyestuffs (Import Regulation) Act.

Mr. Hogge asked the President of the Board of Trade if he was aware that it was the practice of the Dyestuffs Committee, when an application was made for permission to import certain German dyes not made in this country, to advise the applicant to apply to Swiss agents for the same, and could he give any reason for such proceedings?

Mr. Balfour replied: I understand that, in accordance with the strong wish of the dye-users generally, in consequence of the assistance rendered by the Swiss dye-makers to the textile industries during the war, such advice has been given.

Mr. Raffan asked the President of the Board of Trade whether he was prepared to immediately institute an inquiry on the working of the Dyestuff Advisory Licensing Committee and to hear evidence of specific cases of injury to industries consuming dyes caused by the continual refusal of the licensing committee to grant licences for

specific dyes not obtainable from home sources of supply?

Mr. Baldwin: No, sir. I have no reason to suppose that there is any serious dissatisfaction among dye-users generally with the operations of the Committee, on which the users are strongly represented, and which is discharging a very difficult task with great care and ability.

Major Barnes asked the President of the Board of Trade whether he was aware that applicants for licences to import dyes not made in the United Kingdom were continually being referred to British makers, who admitted that they did not make the exact dye required, but offered some substitute which the consumers state is quite unsuitable; and on what ground the Dyestuff Advisory Licensing Committee refused to grant import licences?

Mr. Baldwin: It is the practice of the Committee to refer applicants for import licences to British makers whenever there is *prima facie* evidence that the latter are in a position to supply dyestuffs identical with or equivalent to those to which the applications relate. If it appears, however, that the supplies offered by British makers are not suitable for a particular consumer's requirements, no licence is granted.

Mr. Galbraith asked what were the number of applications received by the dyestuffs committee for permission to import special dyes from Germany for the reason that such dyes were not procurable in England; and the number which had been granted and the number of similar applications to import dyes from Switzerland?

Mr. Baldwin said that the numbers of licence applications granted and refused could not be given without going through the files. During the year ended Dec. 31, 1921, applications to import 671,032 lbs. from Germany were granted, and applications to import 771,109 lbs. were refused. During the same period applications to import from Switzerland were allowed in respect of 1,796,754 lbs., and refused in respect of 502,579 lbs.

DYES FROM GERMANY.—In the House of Commons on Monday, Mr. Hilton Young, Financial Secretary to the Treasury, informed Lt.-Col. Willey that the total weight of dye-stuffs received by this country from Germany by way of reparation up to Dec. 31 last was 4,070 tons, in respect of which approximately £570,000 (or £140 a ton) was credited to Germany; 2,400 tons have been sold for approximately £381,000

(after the deduction of expenses of realisation), at £228 a ton, which therefore represented the values ruling at the dates of sale.

GAS POISONING.—In the House of Commons, Mr. Baldwin, President of the Board of Trade, informed Mr. T. P. O'Connor that, in accordance with the recommendations of the Carbon Monoxide Committee, an Order was made by the Board of Trade on Feb. 16, prohibiting the supply for domestic purposes of gas containing carbon monoxide, unless such gas possessed the distinctive pungent smell of coal gas, and the Board of Trade were carefully watching the position. There had, however, been no marked change recently in the proportion of water-gas supplied by gas undertakings.

Sir L. Worthington-Evans stated that experiments on the results of gas poisoning were being carried out at Porton, near Salisbury. The animals employed had been rabbits, rats and goats, and the total number in each case was 20, 23, and 22 respectively. The experiments were of the same nature as those carried out with animals in the course of general medical research at universities, hospitals, and other recognised institutions, and they were conducted under the same statutory safeguards.

IMPORTANT NOTICE.—Mr. H. Hugh Hughes having resigned, Mr. Victor Blagden, of Messrs. Victor Blagden & Co., Ltd., Corporation House, 4, Lloyd's Avenue, London, E.C.3, has been unanimously elected President of the British Chemical Trade Association and Chairman of the General Committee.

IMPORTANT.

Home Office, Whitehall.

3rd March, 1922.

GENTLEMEN.—I am directed by the Secretary of State to refer to the draft Regulations under Section 79 of the Factory and Workshop Act 1901, to apply to manufactures and processes incidental thereto carried on in chemical works, which were issued on the 24th December, 1920. The Secretary of State has given careful consideration to the objections and suggestions submitted to him with regard to the Regulations, and as a result of conferences with representatives of the various branches of the Industry, at which the Regulations were discussed in detail, he is prepared to

make certain modifications which are incorporated in the enclosed revised draft. These modifications will, he hopes, make the Regulations acceptable to all concerned and avoid the necessity of a formal inquiry. The revised draft is, he understands, accepted by the Association of British Chemical Manufacturers and the various other Employers' Organisations affected.

The principal alteration is the withdrawal of Regulations 12 to 15, which required provision for the welfare of the workers to be made in all works to which the code applies. Owing to the prevailing industrial depression, the Secretary of State has reluctantly agreed to the limitation for the present of such provision to the workers employed in the processes specified in Part II, which involve special danger to health. He has also agreed not to bring into force immediately some of the provisions which would involve structural alterations at the works concerned.

Before the Regulations can be formally made the provisions of the Act require that the draft Regulations shall be republished as amended, and he accordingly gives the following formal notice:—

"That he proposes to make regulations to apply to the manufactures and processes incidental thereto carried on in chemical works in accordance with the draft, copies of which may be obtained on application to the Factory Department, Home Office, London, S.W.1, and that any objection with respect to the draft Regulations by or on behalf of any person affected thereby, must be sent to the Secretary of State within 21 days from this date. Every such objection must be in writing, and must state (a) the draft Regulations or portions of draft Regulations objected to, (b) the specific grounds of objection, and (c) the omissions, additions and modifications asked for."—I am, Gentlemen, Your obedient servant, MALCOLM DELEVINGNE.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, 16 AND 18, OLD QUEEN STREET, WESTMINSTER, LONDON, S.W.1.—The report described below has been published by His Majesty's Stationery Office for the Department of Scientific and Industrial Research. Copies, price 25s. (by post 26s.) may be obtained through any bookseller, or direct from H.M. Stationery Office at the following addresses:—

Imperial House, Kingsway, London,

W.C.2, and 28, Abingdon Street, London, S.W.1;

37, Peter Street, Manchester;

1, St. Andrew's Crescent, Cardiff;

23, Forth Street, Edinburgh; or from

Eason & Son, Ltd., 40 and 41, Lower Sackville Street, Dublin.

TECHNICAL RECORDS OF EXPLOSIVES SUPPLY, 1915-1918, No. 5.—*Manufacture of Sulphuric Acid by Contact Process*.—The fifth report has now been issued of the special series which is being published for the Department of Scientific and Industrial Research in order to make available, for the benefit of the industries concerned, results of scientific and industrial value contained in the technical records of the Department of Explosives Supply of the Ministry of Munitions.

The subject is dealt with under the following headings:—

Section 1. Mannheim Oleum Plant: General outline and description of plant; Pyrites store; Crusher plant; Description of Oleum plant; Operation of the plant; Plant control; Some Notes on the Working of the plant burners; Method of calculating percentage conversion and percentage composition of burner gases; Graphs for calculating percentage conversion of SO_2 to SO_3 , and percentage of SO_2 in burner gas.

No. 6.—*Synthetic Phenol and Picric Acid* (Price 15/-, by post 17/6).—A special series of reports is being published for the Department of Scientific and Industrial Research in order to make available, for the benefit of the industries concerned, results of scientific and industrial value contained in the technical records of the Department of Explosives Supply of the Ministry of Munitions. The work recorded was done at or in connection with some of the National Factories during the war. The preparation of the necessary abstracts of information was begun by the Ministry of Munitions at the close of the war, and arrangements were afterwards made by the Department of Scientific and Industrial Research to complete them.

The following reports in this series have already been published:—

No. 1.—*Recovery of Sulphuric and Nitric Acid from Acids used in the Manufacture of Explosives: Denitration and Absorption*. Price 12s. 6d., by post 13s.

No. 2.—*Manufacture of Trinitrotoluene (TNT) and its Intermediate Products*. Price 17s. 6d., by post 18s.

No. 3.—*Sulphuric Acid Concentration*. Price 12s., by post 12s. 7d.

No. 4.—*The Theory and Practice of Acid Mixing*. Price 12s., by post 12s. 6d.

No. 5.—*Manufacture of Sulphuric Acid by Contact Process*. Price 25s., by post 26s.

Section 2. Grillo Oleum Plant: General outline and description of plant; Raw material; Varieties of acid produced; Description of the plant; Production of the magnesium sulphate mass; Chemical control; Sulphur dioxide losses in purification; Report on the appearance of a Grillo unit at Queen's Ferry after fifteen months' continuous work; Report on thermal values and efficiencies on a Grillo plant; Calculations involved in the design of the plant, etc.

Appendix I. Calculations used in determining the heats of dilution of different strengths of sulphuric acid.

Appendix II. Humidity of air and allied data.

Appendix III. Feed chart for contact plant; Production chart for Grillo plant.

Owing to the cost of this volume, no copies are available for distribution by the Department of Scientific and Industrial Research.

NOTES ON BOOKS.

Confectioners' Raw Materials, their sources, modes of preparation, chemical composition, chief impurities and adulterations, their more important uses and other points of interest, by JAMES GRANT, J.P., M.S.C.Tech., F.I.S., F.C.S., Head of the Foodstuffs Department, College of Technology, Manchester. Edward Arnold & Co., Ltd., London, 1921. Price 8/6 net.

A sound, scientific work, dealing with confectioners' raw materials, it is a comparatively new departure. Hitherto what scanty literature has been available on the subject has been chiefly in the form of trade recipes and occasional notes in various journals. The author's aim has been to give a general knowledge of the scientific principles involved in the art of confectionery. The present age has been aptly termed the age of substitutes—a generalisation that has been brought home more or less forcibly to everybody during and since the war.

Although the book will be found of value to cookery teachers, the work is primarily intended for the aid of confectioners, and in the hands of an intelligent person it will

greatly help to remove rule of thumb and traditional methods of working, to the undoubted benefit of the confectionery worker. In a general introduction the fundamental principles of the chemistry of the subject are briefly stated, and in Chapter 2 alcohols and alcoholic beverages used as flavouring materials are described. Chapters on fats and carbohydrates are given, together with some illustrations, not only of apparatus employed in various processes, but also some extremely good photo-micrographs of wheat, barley, rye and maize starches. Other pictures of maize, corn, rice berries and the maize plant are reproduced. Photographs are also given of sugar cane plantations and similar subjects.

In a chapter on eggs and egg productions it is stated that during the war South Africa exported great quantities of ostrich eggs for confectionery uses. Various methods are given for the preservation of eggs, and it is pointed out that no satisfactory egg substitutes have been obtained, the so-called egg powders consisting of some protein body coloured with turmeric or some other dye.

In a chapter on colour and colouring matters, a very brief account is given of the theory of light. This is of necessity brief, but what statements are made are those of fundamental importance. In this chapter a prescription is given for the preparation of carmine from cochineal, which we hope does not enter very largely into the preparations of the confectioner.

In a chapter on some general methods of using raw materials some short recipes are given, and the causes of some of the faults in cake-making are explained. A final chapter on the analysis of raw materials is likely to be outside the scope of the practical confectioner, but will be of considerable value to teachers and instructors. The book concludes with a bibliography of works more or less connected with foodstuffs, and there is a very complete index.

The measurement of Steady and Fluctuating Temperatures, by R. ROYDS, M.S.C., A.M.I. Mech.E. Constable & Co., 10, Orange Street, Leicester Square, London, W.C., 1921. Price 16/-.

The measurement of temperatures is a matter that is becoming of increasing importance in almost every branch of industry, and particularly in those connected with high temperatures such as the manu-

facture of alloys, steels, ceramics, glass, &c.

The first two chapters deal with the measurement of temperatures and the construction of mercury thermometers. Chapter 3 deals with electrical thermometers and pyrometers, and full descriptions with diagrams and other illustrations are given of most of the instruments that are used at the present day.

Chapter 4 treats of radiation, optical and other forms of pyrometers, and a special chapter is devoted to the calibration of thermometers for use above the boiling point of water. The final chapter gives a full description of the present day methods of measuring rapidly fluctuating temperatures, a matter of very considerable interest to engineers. This section is very fully illustrated by pictures and diagrams of the very latest devices used in these intricate and important estimations.

At the end of the book some data are given of standard boiling and melting points and other useful matter.

An Introduction to the Analytical Chemistry of the Rarer Elements, by LOUIS J. CURTMAN, Assistant Professor of Chemistry, Chief of the Division of Qualitative Analysis. New York, 1922.

In this modest little book of some 64 pages, the author has given a large amount of analytical data that have resulted from laboratory practice. He states that every experiment described has been personally carried out by himself. The somewhat wide title of the *Rarer Elements* includes the metals of the Platinum group, Gold, Thallium, Selenium, &c., as well as those elements included in the special designation of Rare Earths.

Recognising the objection to including experiments on the rarer elements in a laboratory course, on the ground of their expense, the experiments described are made with very small though definite quantities of materials.

The book deals only with the chemical reactions of the elements, no other information being given, and we cannot help thinking that the general student will find great difficulty in obtaining some of the materials described. In the case of the rare earth metal Erbium it is stated that a precipitated oxalate of it has a light rose colour. This colour could only be visible when dealing with very pure materials, which are unquestionably very difficult to obtain. The

reactions of yttrium and erbium alone are given of those elements included in the yttria earth series. The remainder, among which we notice the author has put Scandium, are mentioned only by name.

The author, in his preface, states that the book may be used to complete a one year's course in qualitative analysis, or as an introductory textbook in a special course on the rarer elements. It undoubtedly contains a very valuable number of reactions that can be easily carried out by a student, and under the direction of a fully qualified teacher will be found of great value as a first step into one of the most fascinating fields of chemical research.

The Physical Properties of Colloidal Solutions, by E. F. BURTON, B.A. Cantab, Ph.D. Toronto. 2nd Edition with 18 illustrations, 213 pp. Price 12/6 net. Longmans, Green & Co., London. Monographs on Physics Series, edited by Sir J. J. Thomson, O.M., F.R.S., and Frank Horton, Sc.D.

The author states in his preface that this second edition is a thorough revision of the first. The important part that colloids and colloidal solutions play in natural economy is becoming recognised in every branch of scientific activity, and this second edition of the author's valuable treatise will be welcomed by every one. The work is very fully illustrated, and full references are given for statements made. Some remarkable diagrams are furnished of the oscillations of particles of various sizes and in various solutions, and Svvedberg's researches on the Brownian movements are given in detail. The book contains a mass of information upon the subject in all its branches, and in a short, concluding chapter it gives a few practical applications of the study of colloidal solutions. We cannot help thinking that this section could be greatly extended. The practical applications following the knowledge of colloids are increasing daily, and it will probably not be very long before we may welcome the third edition of Dr. Burton's valuable treatise.

BOOKS RECEIVED.

"Colloid Chemistry of the Proteins," Prof. Dr. Wolfgang Pauli, translated by P. C. L. Thorne, M.A. (Cantab), A.I.C. Pages: xi.-140. Messrs. J. & A. Churchill, 7, Great Marlborough Street, London, W., 1922. Price: 8/6 net.

"Isotopes," F. W. Aston, M.A., A.I.C., F.R.S. Pages: viii.-152. Messrs. Edward Arnold & Co., 41 & 43, Maddox Street, London, W.1., 1922. Price 9/- net.

"The Elements of Fractional Distillation," Clark Shove Robinson. Pages: ix.-205. Messrs. McGraw Hill Publishing Co., Ltd., 6 & 8 Bouverie Street, E.C.4. First Edition, 1922. Price: 12/6 net.

"A Concise History of Chemistry," T. P. Hilditch, D.Sc. (Lond.), F.I.C. Pages: xi.-276. Messrs. Methuen & Co., Ltd., 36, Essex Street, W.C. Second Edition, Revised, 1922. Price: 6/-.

"A Comprehensive Treatise on Inorganic & Theoretical Chemistry," J. W. Mellor, D.Sc. Pages: Two Volumes, Vol. 1, xvi.-1,065 Pages; Vol. 2, viii.-894. Messrs. Longmans, Green & Co., 39, Paternoster Row, London, E.C.4, 1922. Price: £3 3s. each, net.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 3962—E. E. Dutt.—Process for extraction of titanium dioxide and vanadium salts from bauxite. Feb. 10th.
 - 3963—E. E. Dutt.—Process for extraction of uranium and radium compounds from bauxite. Feb. 10th.
 - 3626—A. F. MacLaren.—Treatment of sulphide pres. Feb. 7th.
 - 3745—R. Sallmann.—Manufacture of chromium compounds of azo dye-stuffs. Feb. 8th.
- Specifications Published this Week.*
- 153254—L'Air Liquide, Soc Anon, Pour l'Etude et l'Exploitation des Procédés G. Claude Catalytic materials adapted for use in the synthesis of ammonia.
 - 174554—W. Carpmael.—Process for manufacture of hydroquinone.
 - 174555—H. Mayers and Britons, Ltd.—Furnaces for the production of mineral distillates of definite composition.

Abstract Published this Week

Extracting Metals: Sodium Salts. Patent No. 17,337. A process of extracting metals has been invented by Mr. F. L. Naef, 110, Loughborough Road, West Bromford, Nottingham, in which finely-divided sulphides of lead, bismuth, silver, mercury, cobalt, or iron, or compounds of cobalt with arsenic, or with sulphur and arsenic, are treated with solid caustic soda or with a mixture of caustic soda and sodium carbonate, common salt, sodium sulphate, sodium sulphide or hydrosulphide, calcium carbonate or lime, in the presence of hydrogen or gases containing hydrogen, and with or without the addition of powdered coal. In the case of cobalt, the presence of hydrogen may be dispensed with. Sulphides, hydrosulphides, thiosulphides, and arsenic compounds of sodium are formed, and the metals are precipitated. The molten salts may be poured off or the whole mass may be treated with water to dissolve the salts.

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THE MINISTRY OF AGRICULTURE AND FISHERIES has for disposal, and invites tenders for the purchase of, the contents of an analytical and chemical laboratory, including reagents used in connection with research work at the Herts. Research Laboratory, Mount Pleasant, London, E.C.1. There is also a quantity of factory apparatus used for the manufacture of rat bait.

A list of the articles for disposal will be supplied upon application to the Disposal Officer, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

Application for permission to inspect the apparatus should be made direct to the Research Chemist at the Laboratory. (Telephone: City 181).

NOTICES.

EDITORIAL.—All literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the EDITOR.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3231.

ANNUAL MEETING—BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION.

HELD AT QUEEN HOTEL, BIRMINGHAM, MARCH, 1922.—Progress in non-ferrous metals research was revealed at the second annual meeting of the British Non-Ferrous Metals Research Association, held at Birmingham on March 3rd, after luncheon at the Queen's Hotel. Mr. T. Bolton, who presided, comprehensively surveyed the activities and progress of the Association, which has now over 100 member firms. A number of important investigations are being conducted by the Association in various laboratories. He emphasised the fact that division of labour is as important among brain workers as among hand workers, and co-operative research was the best and most economical method. He referred particularly to the proposal of the Association to establish University Fellowships for post-graduate research.

Vice-Admiral Sir George Goodwin urged the Association to make its work more widely known, and stated that marine engineers and shipbuilders would be prepared to listen to proposals for membership if the Association's programme were put before them. The scientific metallurgist, the manufacturer, and the user should have their knowledge and experience combined for the benefit of themselves and the nation.

Dr. W. Rosenhain, F.R.S., of the National Physical Laboratory, illustrated the fact that solutions to many non-ferrous problems cannot be found because present knowledge is insufficient. To make good this deficiency both men and money were required. The conduct of research through a Research Association was particularly desirable, because it formed a channel through which research could be applied.

Sir Henry Fowler, Chief Mechanical Engineer to the Midland Railway, emphasised the importance of research to users of non-ferrous metals, and trusted that the railway companies would soon be in a position to support such work. Lack of co-operation meant a loss of brains which could ill be spared. Users could help the Association as members by testing materials under service conditions.

A tribute was then paid to the work of the Chairman of the Association, and emphasised the fact that research should preferably be handed over to specialists. In the factory it was frequently neglected for other pressing work.

Sir Frank Heath, Secretary of the Scientific and Industrial Research Department, congratulated the Association on the extraordinary way in which its membership and activities had expanded during the previous year. He gave several illustrations to show the value of co-operations between user and producer. He thought the provision of an intelligence service was one of the most valuable things an Association could do, he was also particularly interested in the projected establishment of research studentships, and offered the assistance of his Department in working out a scheme. The growing appreciation of the value of research was indicated by the absence of any reference to his Department in the proposals made by the Geddes Committee.

Sir Richard Threlfall urged members not to be impatient for results. The results of research might not be merely deferred, but might not be realised at all. Some research could be done for money and business conditions applied to it, but for other investigations this did not apply.

After a vote of thanks to the Chairman a most successful meeting terminated.

THE ATOMIC THEORY IN 1921.

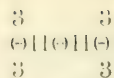
(Continued from Last Week.)

Presidential Address, Section B., S. African Association for the Advancement of Science, Durban, by James Moir, M.A., D.Sc., F.R.S.S.A., F.I.C., F.C.S.

DISINTEGRATION EXPERIMENTS.—It has been stated above that the particle which hits a heavy nucleus full-on is reflected back. This is not the case, however, when the nucleus in question is small. In that case the nucleus is carried on in front of the impinging particle, and the atom is thus disintegrated. The simplest case is that of hydrogen gas or of organic compounds containing much hydrogen, e.g., wax; when these are bombarded with α particles, hydrogen nuclei (i.e., hydriums) are expelled. They are recognised by travelling far further than the α particles themselves can travel against a resistance. Their weight is 1 with a positive charge 1: their initial velocity is 3-4 times that of the α particle. Their diameter is said to be

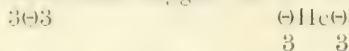
about 3×10^{-8} cm., that of the α particle being about 5×10^{-10} cm. Now Rutherford, 2 or 3 years ago, made the astonishing discovery that the same kind of particles could be obtained by bombarding nitrogen gas or certain solid compounds of nitrogen with α particles. We conclude that they come from the nucleus of the nitrogen atom, which thus contains hydrogen nuclei, in a sufficiently separate form for them to be capable of receiving a direct impact from an α particle. Cheek experiments with CO_2 and O_2 as gases, and with silica and graphite as solids, gave negative results. A mixture of 7½ per cent. hydrogen gas with 92½ per cent. CO_2 or oxygen behaved towards the α particle exactly like nitrogen gas, giving the same number and intensity of "hydrogen particles." By means of magnetic deviation they were shown to have mass 1 and charge 1. The infrequency of the direct impact required to generate "hydrogen particles" is shown by Rutherford's estimate that only one in 300,000 of the α particles hits in the required way. Of the other elements tried, boron, fluorine, phosphorus, sodium, and aluminium were also found to contain remarkable hydrogen, but Li, Be, C, O, Mg, Si, S gave negative results. It is probable, however, that all the elements are made of hydrogen, but contain it in the form of local condensations of hydron and electrons, which are themselves so stable that they do not break up on impact with an α particle: there are two of these, viz., H^{++} and H_2^{++} .

Rutherford's discovery of the disintegration of nitrogen was so important that he had to publish it at once without waiting to ascertain what the rest of the nitrogen atom was made of. He therefore announced that the atomic weight 14 belonging to nitrogen probably consisted of two hydrogen atoms combined with three helium atoms. On continuing his experiments, however, he soon found that the hydrogen particles were accompanied by another set of characteristic particles 5 to 10 times as many in number which differed from any previously known. From the range and magnetic deviation they were shown to possess mass 3 and charge 2, and thus to be similar to the α particle with only $\frac{3}{4}$ of the latter's mass. Nitrogen of mass 14 was thus inferred to consist of 4 particles of mass 3 instead of 3 particles of mass 4, in addition to the two hydrogen nuclei. Rutherford gives the following diagram:—



but expressly states that the arrangement is arbitrary.

Since carbon and oxygen give no hydrogen particles, Rutherford infers that carbon is $3\ominus 3$ and oxygen is $3 \quad 3$ the three



elements N, C, and O thus being depicted as having in their nuclei an excess of plus charges, which is 7, 6 and 8 respectively, agreeing with their atomic numbers. As explained above, the 3^{++} and He^{++} particles are not capable of being disintegrated.

I am immensely interested in these conclusions, for some of you may remember that many years ago, long before the conception of a nucleus for the atoms arose, I predicted* that nitrogen would be found to be CX in which X is an unknown element of atomic weight 2. This prediction was made on purely chemical grounds, such as the relation of pyridine to benzene (see Fig. 5).

I also predicted that carbon would be found to consist of a tetrahedral arrangement of 4 sub-atoms of weight 3, and that oxygen is CX_2 . This paper gave rise to an active discussion, hingeing mainly on the isomerisms which would be postulated by such a theory. Thus nitrogen gas and CO gas would be isomeric, both being C_2X_2 . The extraordinary physical resemblance of these two gases has been recently dealt with by Langmuir.

On Rutherford's modification of my theory, the two gases are no longer isomeric but metameric, because the nuclei differ in weight, but in all other particulars of their constitution they are essentially the same, as will be seen later on.

There appears to be some chance that the element of atomic weight 3 from nitrogen, which I ventured to call *zoicon*, will be found in minerals. After it has lost its positive charges by hitting electrons, the 3 particle (see Fig. 6) must become an inert gas closely resembling helium and possessing a spectrum similar to that of helium with a displacement. This is on the assumption that the inert gas will have

* "Some suggestions for a new atomic theory." Journ. Chem. Metall. and Min. Soc., S.A., April, 1909, page 335, also September, 1909, page 98.

two external electrons just as helium gas has. If, however, it has one electron inside, and another outside, this deduction would not hold, and it would become possible that the new gas is the nebulium of the nebulae, with the constitution $(\Theta 3 \text{ } ^{-})\Theta$ and a spectrum more like that of hydrogen than that of helium. The $3++$ particle is itself probably complex, viz., $H+ \text{ } ^{-}\Theta$, and



the α particle (helium-nucleus) $4++$ is similar (see Fig. 7.)

As regards the monovalent element $X=2$ which I predicted in 1909, Rutherford's discovery seems to indicate that it only exists in nuclei, and that it is constituted $H+ \Theta H+$ (see Fig. 5), so that it yields $H+$ on impact*. This means that the α particle is composed of two of these X elements, and the $3++$ particle is composed of one X and one hydron $+$. The stability possessed by $3++$ and $4++$ is, in my opinion, due to the symmetrical (viz., triangular and tetrahedral) arrangement developed in them when they are made up from $H+ + X$ and $X + X$. In this way Rutherford's conception of oxygen nucleus as CH_8 becomes the same as my conception of it as CX_3 .

To complete this series it may be mentioned that boron appears undoubtedly to be nitrogen minus $3++$, viz.,



In connection with this subatom $X+$, I am very pleased also to find that Prof. Harkins, another pioneer of atomic structure, has now come to the conclusion that it is "the primary group in atom building"***, and agrees with me that the particle is X_2 . Harkins, by the way, writes $X+$ as $p_2 e$, but his p is the same as my notation $H+$, and his e is the electron, so that $p_2 e$ becomes $(H+ \Theta H+)$, which is my conception of $X+$. It is unfortunate that different

scientific writers should chose different terms for the same entity, and I suggest that $H+$ should always be called hydron, not hydrogen-nucleus or proton or H -particle. $X+$ should also have a name, since "isotopic hydrogen" is unsatisfactory: possibly the name *aerion* would do. Harkins uses the very suitable name *neutron* for the nuclear combination $(H+ \Theta)$, which is required according to Rutherford and himself to account for the existence of the elements whose atomic weight is greater than twice their atomic number see rubidium p. 5). Thus chlorine nucleus of at. wt. 35 is $X \text{ } N$, in which N stands for one neutron, and 17 is the atomic number. Aston's Chlorine-nucleus of at. wt. 37 is then $X \text{ } N_3$.

Assuming, then, the sub-atom $X+ (=H+ \Theta H+)$, an extraordinary connection between the inert gases and the saturated hydrocarbons can be demonstrated. CX_4 adds up to 20 and corresponds to neon. C_2X adds up to 36 and corresponds to the lower isotope of argon, with the constitution CX_3CX_3 . Again $C(CX_3)_4 = C_5X_{12}$ (of tertiary butane) adds up to 84 and agrees with the nucleus of Krypton, and has also the required round shape. Similarly CX adds to 132, which agrees with xenon, and $C_{11}X_3$ adds to 228, which may be the highest isotope of niton. Adding three particles to this niton gives $U=240$. The highest possible element would then be $C \text{ } X = 276 = C[C(CX_3)_3]_4$. Some extra binding-electrons are required to give the correct atomic numbers. This kind of formulation puts all the X 's to the outside of the nucleus, and thus explains radioactivity, as the X 's get crowded together on the surface of the nuclei of the higher elements, and are thrown off in pairs, X_2 being the particle. It is thus the accumulation of X rather than that of positive charge which causes radioactivity.

To repeat, the contention I wish to make is that the physicists, as far as I understand them, have placed too much emphasis on the fact that chemical properties depend on the valency electrons, and have not considered the possibility that the arrangement of valencies in CH_4 and NH_4 connotes a *tetrahedral nucleus* for C and N .

(To be continued.)

* He says (Bakerian Lecture). "It seems very likely that the electron can also bind two nuclei . . ." This entails the possible existence of an atom of mass 2 carrying one charge, an isotope of hydrogen, i.e., monovalent.

* I predicted this also in 1909.

** *Nature*, 1921, p. 203.

PROCEEDINGS AND NOTICES OF SOCIETIES.

Provisional Report.

THE ROYAL SOCIETY.

ORDINARY MEETING, MARCH 2, 1922. *Sir Charles Sherrington, President, in the Chair.* The following papers were read (the Summaries here printed having been supplied by the authors for use at the Meeting):—

Prof. L. N. G. FILON, *F.R.S.*, and H. T. JESSOP. On the Stress-Optical Effect in Transparent Solids strained beyond the Elastic Limit.

The paper describes an investigation of the stress-optical effect in glass and celluloid at ordinary temperatures, dealing more particularly with the time-effect in artificial double-refraction in celluloid.

The authors find that the stress-optical effect in glass under simple pressure exhibits no time-effect at ordinary temperatures. In celluloid under simple tension, on the other hand, there is a marked creep in both stress-optical effect and strain even under very moderate loads.

The strain s , and the relative retardation r , of a specimen under constant load are found to bear a relation to the time t , after loading, which is fitted very well by formulae

$$s = s_0 + at + bt^2 \quad r = r_0 + pt + qt^2.$$

The relative retardation and simultaneous strain on loading with a load T are found to be connected by a linear relation

$$r = aT + \beta s.$$

On removing the load, the residual retardation and strain are connected by the law

$$r = \beta s.$$

A theory is worked out which satisfactorily explains this law, on the assumption that celluloid consists of a mixture of two constituents having different elastic and plastic properties and different stress-optical coefficients, the optical-effect in each, however, being strictly proportional to the stress.

W. E. CURTIS. The Structure of the Band Spectrum of Helium. Communicated by Prof. W. H. Hicks, *F.R.S.*

Grating photographs of three of the principal helium bands have been measured and analysed, with the following results:—

(1) Tables showing wave-lengths, intensities, wave-numbers and allocation to series are given, also diagrams exhibiting the structure of the bands.

(2) The chief features of their structure are shown to be accounted for by

the quantum theory of band spectra, a brief resume of which is given.

(3) In each of the three bands a new type of series is found which, although closely related to the others, has not yet received a theoretical explanation. Other departures from the theory are also noted.

(4) It is concluded that the spectrum is due to an unstable helium molecule, having a moment of inertia of about 1.8×10^{-40} gm.cm.

S. DATTA. The Spectrum of Beryllium Fluoride. Communicated by Prof. A. Fowler, *F.R.S.*

The spectrum of beryllium fluoride, hitherto unrecorded, has been investigated. It has been found to consist of six groups of bands, all in the ultra-violet between λ 2800 and λ 3400, and all fading off towards the red.

The strongest band at λ 3009 has been investigated in detail, and has been found to include three series of lines, which depart considerably from the usual type of formula.

The groups of bands have been found to be similar to one of the groups of magnesium fluoride, and are related to this group in accordance with the formula for alkaline earth fluorides proposed in a previous paper.

W. G. PALMER. The Catalytic Activity of Copper.—Part III. Communicated by Sir W. Pope, *F.R.S.*

The present communication is a continuation of previous work on the same subject ('Roy. Soc. Proc.', A 98, 13, A 99, 412), and describes the effect upon the catalytic (dehydrogenating) activity of copper of adding to the metal varying proportions of oxides that are, themselves, weak dehydrogenating catalysts Ferric, manganous, zinc and magnesium oxides were used. Of these, magnesium and manganous oxides enhance the activity of the copper, if present in quantity greater than 1 to 2 per cent., while zinc, and especially ferric oxides, reduce the activity.

A simple theory of catalytic "promoters" is advanced: Small proportions of oxide (less than 1 to 2 per cent.) in general destroy the activity of the copper, presumably owing to solution in the metal leading to diminished adsorption of the alcohol reacted upon.

A new mode of preparing mixed catalytic material is described.

G. B. JEFFERY, *D.Sc.* (1) The Motion of Ellipsoidal Particles Immersed in a Viscous Fluid. (2) The Rotation of two

Circular Cylinders in a Viscous Fluid. Communicated by Prof. L. N. G. Filon, F.R.S.

(1) Einstein has shown that the viscosity of a fluid containing solid spherical particles in suspension is given by $\mu (1+2.5 V)$, where μ is the viscosity of the pure fluid and V is the total volume of the particles per unit volume of the suspension.

This result is extended to ellipsoidal particles, and it is shown that the factor 2.5 is *reduced* by an amount depending upon the shape of the particles, but that it always lies between 2 and 2.5.

An investigation is made of the motion of the particles with regard to the surrounding fluid, and also of the elastic stresses and deformations to which they are subjected by the fluid pressures on their surfaces.

(2) Two problems in the two-dimensional slow motion of a viscous fluid are discussed:—(1) the rotation of a circular cylinder in a fluid contained in a non-concentric cylindrical vessel which may itself rotate about its axis; (2) the rotation of two parallel cylinders in an infinite fluid. It is found that (1) may be solved in finite terms, while (2) is in general insoluble, that is to say, there is no steady motion for which the fluid is at rest at infinity. This result is analogous to that obtained by Stokes for the translation of a single circular cylinder in an infinite fluid.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, THURSDAY, MARCH 16TH, 1922, AT 8 P.M.—The following papers were read:—

Change of properties of Substances on Drying.—H. P. BAKER.

The influence of nitro-groups on the reactivity of substituents in the benzene nucleus. Part VI. The elimination of halogen during the reduction of halogenated nitro-compounds. — H. B. BURTON and J. KENNER.

ROYAL INSTITUTION.—A General Meeting of the members of the Royal Institution was held on the 6th inst., Sir James Crichton-Browne, Treasurer and Vice-President, in the chair. Miss A. Bagot, Mr. W. V. Ball, Miss E. J. Blunt, Mr. S. B. Donkin, Mr. R. E. Gibbs, Mr. G. N. E. Hall-Say, Mr. H. A. Hankey, Miss A. M. Herron, Mr. D. Lucas, Sir Murdoch MacDonald, Mrs. Aylmer Lloyd, Mrs. Reginald

McKenna, Mr. H. B. Moberly, Mr. G. S. Odling-Smee, Mrs. W. Carpenter Scott, Mr. H. Seligman, Mrs. Sharman-Crawford, Professor G. Elliott Smith, Dr. A. Stanley, Mr. C. F. M. West, and Mr. E. Yatman were elected members. On Thursday, March 16, at three o'clock, Dr. P. Chalmers Mitchell began a course of two Lectures at the Royal Institution, on "The Cinema as a Zoological Method." The Friday Evening Discourse on March 17 will be delivered by Professor A. P. Laurie, on "The Pigments and Mediums of Old Masters," and on March 24, by Professor F. G. Donnan, on "Auxiliary International Languages."

THE SOCIETY OF CHEMICAL INDUSTRY.

MANCHESTER SECTION.

At a Meeting of the Manchester Section of the Society of Chemical Industry, held on March 3rd, Dr. E. Arden presiding, a Paper entitled "The Inorganic Constituents of Coal, with especial reference to Lancashire Seams," by F. S. Sinnatt, M.B.E., M.Sc.Tech., F.I.C., etc., and M. Simpkin, M.Sc.Tech., A.I.C., was read by Captain Sinnatt.

The authors of the paper stated that the investigation of the inorganic constituents of Lancashire coals was being continued, and the present paper is concerned with the examination of the modes of occurrence of iron in certain of the coal seams. The work had been carried out under the auspices of the Lancashire and Cheshire Coal Research Association.

In a paper previously read before the Section by Messrs. Bayley, Grounds and Sinnatt, it was shown that the plates of inorganic material (ankerites) found in coal seams were derivatives of calcium carbonate, in which a proportion of the base was replaced by iron (ferrous), magnesium and manganese. It is known that the ankerites undergo oxidation on exposure to air, and that this phenomenon is a factor influencing the disintegration of the masses of coal during storage.

It was suggested in the previous paper, and by several speakers in the discussion which followed its reading, that the ferrous iron and manganese might be of importance as agents leading to the spontaneous heating of coal, whether in the coal or during storage. The present results, it is thought, may have a bearing upon the behaviour of

the ash found when the coals are burned, and may be of value in furthering the discussion upon the influence of the oxidation of the iron present upon the incipient heating of coal.

The work mentioned in the paper largely followed the lines described by Powell, except that additions can now be made to the number of types of iron that he differentiated. Powell distinguished four forms of iron as occurring in the coal substance, and suggests three for the iron occurring as water soluble iron, iron soluble in hydrochloric acid, iron occurring as pyrites, and that present in the form of silicate. In the portion soluble in hydrochloric acid he made no attempt to differentiate between the iron occurring in the form of ankerites and that present in the mass of the coal in other combination. The amount of iron occurring in the for mo ankerites in certain specimens of coal is by no means negligible; one sample examined, in which 4.2 per cent. of ash was present, being found to contain approximately 1.7 per cent. derived from ankerites.

The subject of the different types of iron pyrites is at present being exhaustively investigated microscopically by Mr. J. Lomax, of Bolton, who has already described a number of distinct forms.

The analytical values of three specimens of pyrites were then stated, with a view to showing that their composition is variable, and that, in addition to iron pyrites, they may contain iron in the form of carbonate.

The extraction of iron by water was of some interest in connection with the water in mines. This water contains the iron in the ferrous condition, and in a recent heating which occurred in one of the pits observed by the authors of the paper large crystals were found in one of the masses of coal when the heated zone had been cooled, which, on examination, proved to be practically pure ferrous sulphate.

Iron occurring in the white partings, or ankerites, will readily pass into solution on treatment with acid, but, in view of the fact that many specimens of pyrites which occur in coal contain iron in the form of ferrous carbonate, it is clear that there are at least two sources from which the iron soluble in hydrochloric acid may be derived. Attempts had been made to determine the percentage of ankerites in coal, but without success.

The third part of the examination conducted by the authors of the paper consisted in the determination of the iron di-

sulphide present in the samples by the method suggested by Powell. The details of the experiment having been mentioned, Capt. Simmatt stated that the residual coal was dried and ignited, and the ash carefully examined. It was found that the ash from the majority of the coals left a residue which was entirely free from iron. These prove conclusively that nitric acid completely extracted the whole of the iron from the coal. The results confirmed those of Powell.

Iron in coal may occur in at least five distinct forms, namely, in the ankerites, in ferrous carbonate, soluble iron salts, silicate, and as pyrites.

Results of an investigation of the temperature of decomposition of ankerites were stated in detail.

A discussion followed, in which Messrs. Grounds, Terry, Drummond, Paton, and Samny took part, and to which Capt. Simmatt replied.

"A NOTE ON THE CAUSE OF SPLITTING OF A POTTERY MATERIAL."

BY MRS. M. B. CRAVEN, M.Sc.TECH.,
A.I.C.

In the above-titled Paper, Mrs. Craven described the results of an investigation carried on by her during the war period, with the object of developing an English ring support for the purpose of carrying incandescent mantles. It had not always been found possible to make English earthenware ring supports for incandescent mantles which would withstand the action of heat as well as would those of certain German manufacture. When heated suddenly, the English ones "split off" or splintered. Chemical analysis did not reveal any difference which would account for the success of the one body and the failure of the other. The English clay ring supports split off at the very beginning when the mantle fabric was impregnated with the incandescent oxides, the damage being so great that quite 50 per cent. of the mantles had to be rejected, the remaining 50 per cent., which were good, having to carry the cost of the rejects. Two samples of English clay ring supports were examined, one being of better quality than the other, and also a sample of German manufacture. The investigation was rendered somewhat complicated owing to the fact that stress was laid on the difference probably being one of chemical composition. The German ring was called a magnesia ring.

In order to ascertain whether magnesia was present in the Yerman body a porosity test was undertaken. If magnesium carbonate had been used, then the body would be more porous than ordinary earthenware, and would probably prove to be efficient under the effects of expansion and contraction.

The analysis indicated quite an ordinary body. The inferior English body was slightly higher in alumina content than the German, while the better type of English body was approximately the same as the German. There was no bone ash content. The evidence obtained by the chemical analysis was entirely negative. There was not sufficient difference to account for the success of the German body and the failure of the English one. The German body had a porosity of 12.6, the inferior English 12.7, and the fairly good English body was slightly more dense.

The difference was discovered to be purely physical. Merely by the eye an examination of fractures of the three rings showed considerable differences in appearance. The German body broke with quite a beautiful fracture, without striation, the inferior English body exhibited considerable striations, while the moderately good English body was something like the German one. In the case of the German body the grains were quite even in size, while with the inferior English body the grains were very uneven in size. Microscopic investigations showed that the German body was somewhat badly marked with iron specks, but these did not appear to detract in any form the effective service of the ring. The inferior English body showed air spaces, veins, and striations running throughout the mass, and also little hillocks of material obviously under different stresses. The difference of formation as compared with the German was very marked.

The defect was, therefore, proved to be a mechanical one, due entirely to the lack of proper preparation of the English material. Probably flint had been used in the manufacture of the English body for the purpose of aiding silica. Flint was a very difficult material to use unless ground over a Derbyshire Chert bed. The Germans probably obtained a perfectly even texture by the use of kieselguhr, and through there being no defect with the die. The English die was not perfect. The striations were altogether due to bad pressing. The remedy appeared to be the substitution of kieselguhr for flint, even grinding of the

materials used, and better pressing, or, to sum it up quite shortly, better potting.

A number of microphotographs were exhibited by Mrs. Craven.

A long discussion took place, in which Messrs. Arden, Terry, Drummond Paton, Huebner, and Callan took part, and to which Mrs. Craven replied.

Miss Robinson proposed, and Dr. Henderson seconded, a vote of thanks to Mrs. Craven for her paper.

(1) "The Action of Iodine upon Cellulose, Silk, and Wool," by J. Huebner, M.Sc.Tech., F.I.C., and J. N. Sinha, B.Sc.Tech., B.Sc. (Cal.)

(2) "The Effect of Water and of certain Organic Salts upon Celluloses," by J. Huebner, M.Sc.Tech., F.I.C., and Frederick Kaye, A.R.C.S.

The Authors of the above Papers described them as preliminary notes, and stated that they had discovered that appreciable quantities of pure iodoform are produced by the action of iodine and caustic soda upon highly purified cotton, celluloses made from different kinds of wool, natural silk, some of the artificial silks, wool, rubber, and other substances.

Samples of iodoform which have been actually made from cotton and from other celluloses were submitted for inspection.

In the second note, Mr. Huebner described some of the results of an investigation, carried out jointly with Mr. F. Kaye, on the effect of water on certain organic salts upon celluloses. In this the authors showed that pure cotton and other celluloses, when exposed to water or water vapour for a considerable time, are attacked, and that as a result aldehydic bodies are formed. Aldehydes in quite appreciable quantities are produced when pure cotton is steeped in an aqueous solution of sodium acetate and kept in an incubator for some time.

A discussion followed, in which Messrs. Higgins, Fargher, and Arden took part, and to which Mr. Huebner replied.

GEOLOGICAL SOCIETY OF LONDON. PRESENTATION OF MEDALS.

ANNUAL GENERAL MEETING, FEBRUARY 17th, 1922.—Mr. R. D. Oldham, F.R.S., *President, in the Chair.*

After the presentation of the Reports, the President presented the Wollaston Medal to Dr. Alfred Harker, F.R.S., addressing him as follows:—

Dr. HARKER.—

From the first you have recognised, as you were among the first to realise, the necessity of combining field work with laboratory research. Well qualified by your mathematical training to apply the laws of crystal optics and physical chemistry to petrological problems, your early work on the Hala-volcanic series, the Ship granite, and Carrick Fell established your position as a petrologist and field geologist. Selected in the Geological Survey for the purpose of surveying portions of the Tertiary volcanic region of the West of Scotland, your ten years' service produced two important memoirs, on the Tertiary igneous rocks of Shyre and on the Small Isles of Inverness-shire. In addition to these, and many other records of observations, your work has always been characterised by a breadth of view and a recognition of fundamental principles. Applying the results of physical chemistry to the differentiation of rock-magmas, you have indicated a manner in which a separation of the alkaline and acidic portions might be brought about, and you were the first to draw attention to the correspondence of the distribution of these types with areas characterised by the Atlantic and Pacific types of coast-line. Your work on the "Natural History of Igneous Rocks," and your addresses to the British Association and to this Society, have all been important contributions to theoretical geology. For these reasons the Council has accorded to you the Wollaston Medal, in recognition of those manifold services, by which you have advanced our knowledge of the mineral structure of the earth, both in the narrower and in the more extended meaning of the words.

Dr. Harker replied in the following words:—

Mr. President,—

I wish to express my keen appreciation of the distinction which has been conferred upon me, and to record my thanks to the Council for their generous estimate of my merits. To so high an honour I have never ventured to aspire. If a perusal of the list of former Wollaston Medallists left me with a lively sense of my own unworthiness, this feeling has at least been tempered by the kind congratulations of friends, and now by the graceful words with which you have accompanied the presentation.

The occasion is one which invites retrospect, and the personal note will perhaps be pardonable. Looking back, I acknowledge

that the lines have fallen to me in pleasant places. I should be ungrateful were I to forget the constant support extended to me by my College, or the debt which I owe to Prof. Hughes, who first turned my steps into the paths of Geology. Gratefully, too, I recall the encouragement which I have received from this Society, and from the comradeship of colleagues at Cambridge and many friends in London and Edinburgh. Much of my active life has been passed teaching. If such occupation limits in some measure the time that can be given to private work, it still brings notable compensations. It is good, I think, to be brought back often to first principles, and to be braced by contact with younger and more ardent minds. You, Sir, have emphasised the value of field-work in conjunction with laboratory research. It was by the good offices of Sir Archibald Geikie that I have been enabled to enjoy this advantage also, and to acquire some experience of systematic mapping amid the delightful scenes of the West Highlands.

I wish I could believe that all these favours of fortune have been turned to the best account in the service of Geology, but I am conscious of many shortcomings. There remains the hope that some years of activity may still be left for me to justify, if I can, the honour now bestowed upon me.

The President then presented the Murchison Medal to Dr. John William Evans, F.R.S., addressing him as follows:—

Dr. EVANS.—

Taking up the study of geology, originally from pure love of the subject, you have had an extensive, varied, and fruitful experience. In Western and Southern India, and in South America, you have conducted and controlled important geological investigations, contributing largely by your own observations to, and by your writings to the dissemination of, the results; nor have you feared to attack the more abstruse and polemical problems of theoretical geology, of which you have been an eloquent illuminator and interesting exponent.

Dr. Evans replied in the following words:—

Mr. President,—

It is nearly a third of a century since Prof. Judd awarded to me a medal struck from the same die as that which I have just been so fortunate as to receive at your hands. The former was given as an encouragement to one who was commencing his geological career. This medal, I trust, I

can accept as an assurance that I have not entirely wasted the intervening years. If some may think that, in a life with many calls upon it, I have attempted too much and carried too little to completion, I would plead that I have learnt, as I could not otherwise have done, how vast are the problems which our science presents for solution, and have been enabled to assist the younger men, with whom I have come into contact in my College and Colonial Office work, to realise the wide field of research that lies open before them.

In handing the Lyell Medal, awarded to Dr. Charles Davison, to Prof. W. W. Watts for transmission to the recipient, the President addressed him as follows:—

Professor WATTS,—

The Council has awarded the Lyell Medal to Dr. C. Davison. Not unmindful of his contributions to observational geology, or of his contributions to the problems connected with the constitution and consolidation of the earth, it has based this award mainly on his lifelong devotion to the study of earthquakes. Commencing at a time when he was almost alone, in this country, as a student of the subject, he has steadfastly accumulated a mass of detailed observations and critical discussion, which has very materially advanced our knowledge. His recognition of the duplex origin of certain earthquakes has been fruitful of result, and has been extended by others, until it is now a truism that the origin of an earthquake need not be from a single centre, but may be of a very complex and extended character.

Prof. W. W. Watts expressed his regret that Dr. Davison was prevented by illness from receiving the Medal in person. He pointed out the appropriateness of the award of the Lyell Medal to one who had done so much to prove the uniformity of geological causes at the present day, and whose method of research was essentially Lyellian in character. He asked permission to communicate Dr. Davison's acknowledgment in his own words:—

"It is with no little regret that I find myself unable to be present at the Anniversary Meeting, and I am writing to ask if you would be so kind as to represent me when the Lyell Medal is presented, and on my behalf to thank the President and Council for their award. It is one that, for several reasons, I value very highly, especially because the Medal was founded by the writer of the remarkable chapters on earthquakes in the "Principles of Geology";

and not less because it is presented by the author of the report on the great earthquake of 1897. I should like to take this opportunity of saying that, whatever success my study of British earthquakes may have attained, is owing in great part to the help and encouragement which I constantly received from Prof. Charles Lapworth and from my old teacher, Prof. Lebour."

CHARLES DAVISON."

The President then presented the balance of the proceeds of the Wollaston Donation Fund to Dr. Leonard Johnston Wills, M.A., addressing him as follows:—

Dr. WILLS,—

Commencing your geological record with a study of the Lower Keuper rocks of Worcestershire, a study of the structure of the lower jaw of the Triassic Labyrinthodonts, and the discovery and description of the fossil plants at Bromsgrove, you have rendered more conspicuous service by your geological work on the Palæozoic rocks of North Wales and the Denbighshire coalfield, in the course of which you have developed important suggestions of tectonics and added to our knowledge of the detailed stratigraphy of the region. Nor have more recent deposits been neglected, as is evidenced by your paper on late Glacial and post-Glacial changes in the Dee Valley, and on windworn pebbles in the high-level gravels of Bromsgrove. These studies you are still continuing, and we look forward to the early publication of some of your results. In recognition of the work done, and as an encouragement to future effort, the Council has awarded to you the balance of the Wollaston Fund, which I now hand to you in the name of the Society.

THE INSTITUTE OF METALS.

ANNUAL GENERAL MEETING, MARCH 8 & 9.

Held at the House of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1.

Summary of "Notes on the Corrosion and Protection of Condenser Tubes," by G. D. Bengough, M.A., D.Sc., Member (Investigator to the Corrosion Research Committee), presented at the Annual General Meeting of the Institute of Metals, held in London, on Wednesday, March 8th, 1922.

Dr. G. D. Bengough's "Notes on the Corrosion and Protection of Condenser Tubes" deal with ten year's scientific investigation of the problem on its practical side. The recommendations are specific and categorical, and the document should be of considerable service to manufacturers

of tubes and condenser plants, and to the engineers who use them.

Summary of Paper by Frank Adcock, M.B.E., B.Sc., Member (Fiddington), on "The Internal Mechanism of Cold Work and Recrystallisation in Cupro-Nickel," presented at the Annual General Meeting of the Institute of Metals, held in London, on Wednesday, March 8th, 1922.

The problem was attacked in a conventional manner, by observing under the microscope the polished and etched surfaces of metal specimens which had been subjected to various degrees of cold working and heat treatment.

Cast cupro-nickel, annealed until homogeneous, was selected as a suitable basic material, since good etchings were obtainable with the nitric acid attack electrolytically. The metal was able to withstand a considerable amount of cold working, and yet was sufficiently hard to permit of rapid preparation for micro examination.

Material which had been subjected to reductions of 50 per cent. and 88 per cent. by cold working was examined, and observations were made on the nature and direction of certain strain planes which passed through most of the crystal grains of the distorted metal.

The possibility of a gradual distortion of the crystal structure apart from "slip" is also dealt with, and reference is also made to the oxides which appeared on etching the worked material.

In order to follow the process of recrystallisation, cold worked specimens which had been annealed for fixed periods at one or more progressively higher temperatures were examined microscopically.

It was noticed that the first effect of annealing was the accentuations of the "strain" markings previously visible in the worked specimens, followed at higher annealing temperatures by the appearance of new crystal grains which were generally associated with the previously mentioned "strain" markings and occasionally with old crystal grain boundaries.

New grains which appeared on the sites of the "strain" lines were frequently elongated in the direction of these lines, and not necessarily in the direction of rolling and, further, the crystalline orientations of such grains were apparently not related to that of the old grain in which they were born.

A theory is put forward as an attempt to explain some of the experimental facts

which are not altogether in agreement with the usually accepted views on the subject.

The hardness of the cold worked metal as indicated by the "Brinell" test did not begin to fall appreciably until the annealing temperature employed was such that new crystal grains were readily discernible under the microscope.

The paper is illustrated by thirty-six photographs.

Summary of Paper by the Research Staff of the General Electric Company (London), (work conducted by Major C. J. Smithells, M.Sc.), on "The Effect of Impurities on Recrystallisation and Grain Growth," presented at the Annual General Meeting of the Institute of Metals, held in London, on Wednesday, March 8th, 1922.

This research was undertaken to determine the effect of small quantities of impurities in tungsten on the structure developed on annealing. Tungsten wires were prepared, containing accurately known quantities of thorium, alumina, silica, lime, and the alkali metal oxides, in various proportions. The progressive changes in crystal structure on annealing at 2,500° K were followed in each case, and the distribution of the impurities in the metal determined. It was found that the refractory oxides, which ultimately segregate in the grain boundaries, exert a definite resistance to grain-growth. An entirely new type of exaggerated growth has, however, been found to take place on annealing tungsten containing a few tenths per cent. of both a refractory oxide and an alkali metal oxide. Single crystals occupying the entire cross-section of the wire, and three hundred times as long as their diameter, are formed on annealing for a fraction of a minute.

The authors put forward an hypothesis based on the idea that crystal growth and recrystallisation in metals depends on a difference in vapour pressure between neighbouring crystal grains. On this hypothesis the new type of exaggerated grain-growth is satisfactorily explained.

The authors then proceed to a critical survey of published work on recrystallisation and grain-growth from the point of view of the vapour pressure hypothesis. They show that it explains the known phenomena in relation to the effect of strain, grain-size, and temperature in regulating recrystallisation and grain-growth on annealing.

The paper is well illustrated with photomicrographs, showing the development of

the various types of structure produced on annealing tungsten containing different impurities.

Summary of Paper by H. Moore, O.B.E., Ph.D., F.I.C., Member, and S. Beckinsale, B.Sc., Member (Woolwich), on "Further Studies in Season-Cracking and its Prevention: Condenser Tubes," presented at the Annual General Meeting of the Institute of Metals, held in London, on Wednesday, March 8th, 1922.

The work reported in this paper has been carried out with a view to the application to Admiralty condenser tubes of the low temperature annealing, previously recommended by the authors for the removal of internal stress in brass and the consequent prevention of season-cracking. Split tubes showed the usual characteristics of brass which had failed by season-cracking. The properties of condenser tubes of 8 different makes, and also of a quantity of tube purposely made by methods inducing a state of high internal stress were determined before and after annealing at temperatures in the range 250° to 325° C. By numerous annealing experiments on flat strips of condenser-tube brass elastically bent to an arc of a circle, and thus initially stressed to a known amount the effects of (1) initial hardness, (2) initial stress, (3) time, and (4) temperature, on the reduction of initial stress by low-temperature annealing were separately determined quantitatively. It was shown that:

1.—The rate of reduction of stress at the lower temperatures is fairly rapid at first, but becomes slow when the stress has been considerably reduced.

2.—As the temperature is raised the rate of reduction of stress increases.

3.—The higher the initial stress, the higher is the remaining stress after a given treatment, in condenser tube brass of the same hardness.

4.—The higher the hardness of the brass, the lower is the remaining stress after a given treatment and for a given initial stress.

The elastic limit and yield point of cold-worked condenser-tube brass were found to be raised by treatments which would greatly reduce initial stress, a temperature of 250° to 275° C being the most effective in restoring elasticity in the overstrained material. The Brinell hardness of condenser tubes is commonly between 140 and 160, having been raised considerably by the final cold-drawing. Treatment at 280° to

300° C for 30 minutes is recommended for condenser tubes. This treatment reduces any initial stress present to a safe limit without injury to and in some cases with marked improvement in the strength of the tube.

CHEMICAL NOTICES FROM FOREIGN SOURCES

SOLUTION OF ADRENALIN FOR INFECTIONS.—*L. Debucquet*.—A saturated aqueous solution of benzoic acid is a very valuable solvent for adrenalin, the best proportions to use being:—

Adrenalin	...	...	1 gramme.
Pure Sodium Chloride	...	1	"
Saturated Solution of Benzoic Acid	...	...	1000 cc.

This solution is exceedingly sensitive to the action of alkalis, and especially to ammonia, which turns it pink. Iron per chloride gives a blue green colouration which changes to violet if the previously acid solution is neutralised. The rotatory power is constant, and its physiological activity is the maximum obtainable. The solution is acid, but this fact causes no inconvenience, and very probably the physiological activity is due to the acidity of the medium. The benzoic acid acts as an antiseptic, and the solution remains active and keeps well.—(*Journal de Pharmacie et de Chimie*, XXV., No. 4, 1922.)

RELATION OF CHEMICAL CONSTITUTION AND THERAPEUTIC PROPERTIES.—*Paul Putzys*.—The chain $>CO$ is hypnophoric, and in the series of ketones the appearance of utilisable hypnotic effects is connected with the presence of the ethyl radical C_2H_5 . Thus ordinary acetone $CH_3-CO-CH_3$ produces an intoxicating effect and affects the heart, but diethyl ketone $C_2H_5-CO-C_2H_5$ is a hypnotic which does not act upon the heart. The accumulation of 3 hypnophores in the molecule seems to raise the hypnotic effect. The halogens combined with alkyl radicals act as hypnophoric agents, and the hypnotic character of a compound seems to be an additive property. The activity of a compound depends not only upon the radicals it contains, but also upon the way in which they are arranged, and thus isomerism plays an important part in determining the properties of a compound. A good example of this is benzoic ortho sulphimide or saccharine, the para derivative being quite tasteless; also cocaine, which differs only from cocaine in the posi-

tion of the carboxyl group, has no anæsthetic action, and leuco-solatory hyoseyamine is from 12 to 18 times as toxic as the dextro compound. Strychnine contains a lactame group $\text{C}=\text{O}$, in which the two

NH

free valences are bound to the same molecule, and this group seems to possess tanning properties. (*Journal de Pharmacie Belgique*, IV., 1922, No. 7.)

SUBSTITUTES FOR CAMPHOR IN THE MANUFACTURE OF CELLULOSE.—A. Hafin. —Triphenyl and tritolyl-phosphates have been employed successfully as substitutes for camphor in making celluloid, while triacetate, ethylacetanilide and other substances can be used to replace part of the camphor. Most of the substitutes proposed are acids, amines or esters, all of which are saponified or hydrolysed easily, and thus produce acids which accelerate the decomposition of the compound and act upon the nitrocellulose. The chemical properties of camphor make it the ideal solvent for nitrocellulose. It is a saturated cyclic ketone, and thus a relatively stable compound, but is oxidised by the air at the ordinary temperature. The best substitutes for camphor are compounds of similar structure and triphenyl phosphate and tritolyl-phosphate are the only two which have been employed successfully on the large scale. The former is a white solid, melting at 49.90° , while the latter is a viscous liquid which becomes very thick at 30° but does not solidify. They are both colourless substances with neither taste nor smell, non-volatile, stable in air and water, and boiling at a very high temperature. They do not become coloured on exposure to light. They resemble camphor in their behaviour towards cellulose.—(*Moniteur Scientifique* XII., No. 959, February, 1922.)

METHOD OF DETECTING THE PRESENCE OF LACTIC ACID.—L. Hartweg and B. Saar. —The liquid to be examined must not contain more than 0.2 per cent. of lactic acid. Two cc. of concentrated sulphuric acid are added to 0.2 cc. of the liquid, and the mixture is heated for two minutes on the water bath, and then cooled by a current of cold water. Then a couple of drops of a five per cent. solution of guaiacol are added, and if lactic acid is present a red colouration appears. To detect lactic acid in yeast 3 gr. are ground up in a mortar with a little water, and a drop of methyl orange and of phosphoric acid are added. The liquid is then mixed with sand and calcined gypsum

and allowed to harden. The material is then broken up and extracted with ether in a Soxhlet's apparatus. When the ethereal solution is concentrated, a strongly acid black syrup remains if lactic acid is present. A 0.2 per cent. solution of it is then made and tested as described above. Formic, acetic, malic, citric, benzoic and salicylic acids give no colouration in these conditions, but tartaric acid gives a faint pink colour, which, however, cannot be confused with the red colouration given by lactic acid.—(*Chem. Ztg.*, XLV., 1921, No. 10.)

NOTES ON BOOKS.

Soaps and Proteins, their colloid chemistry in theory and practice, by MARTIN H. FISHER, GEORGE D. McLAUGHLIN, AND MARIAN O. HOOKER.

The author states that the widely differing theoretical and practical problems associated with normal physiology in plants and animals, and with the treatment of their diseases are essentially problems in colloid chemistry. Soaps were chosen on account of their chemical behaviour being similar to that of the proteins.

The book is divided into three parts—Part I., the colloidal chemistry of soaps, occupying the main portion of the book. The subject is dealt with exhaustively, and is very freely illustrated with photographs and original diagrams. Part II. deals with the colloidal chemistry of soap manufacture, and Part III. is devoted to the analogues in the colloidal chemistry of soaps, protein derivatives, and tissues. The book concludes with a short appendix giving physico-chemical constants and other data.

We have received from Messrs. Longman, Green & Co., publishers to the Manchester University Press, the Roll of Service of the Manchester University, giving the names of all those members of the university who took part in the recent war. A short preface is given by the vice-chancellor, Henry A. Miers, giving the details of the roll and adding a few words to future generations of students as to the example of those who went out from the university and offered their lives for their country in the great war. The vice-chancellor points out that heroism is no monopoly of war, and that there are sacrifices as great as that of life, and hardships equal to those of battle.

The list of those university men who fell in the great war has been arranged in

alphabetical order, with the details of their careers and the manner of their deaths, and occupies some 80 pages, and following that some 200 pages are taken up with the names of those who served in the Army and Navy. The roll can be obtained from the publishers, 39, Paternoster Square. Price 10/- net.

"Sell's Registered Telegraphic Addresses and Classified Trades Directory of Great Britain and Ireland," Messrs. Sell's, Pages: xxviii.-2,976. Messrs. Sell's, 1922 Edition (37th year). Price: 45/-.

A SENSITIVE TEST FOR PHENOLS, BY JAMES MOIR, M.A., D.Sc., F.I.C.—*Read 19th September, 1921.*—For phenols as such—i.e., not in solution, the best test is undoubtedly the distinctive colour of the phthaleins produced when the specimen is gently warmed with a trace of *p*-oxybenzoylbenzoic acid and a drop of sulphuric acid, and the result dissolved in ammonia (see Moir, *Trans. Royal Soc., S.A.*, 1918, 112; also Orndorff & Murray, *J. Amer. C.S.*, April, 1917).

It is well-known, however, that the ordinary tests for phenols break down if the reaction of the fluid to be tested is either markedly acid or markedly alkaline. The ferric chloride coloration for example can in practice only be obtained with a pure aqueous distillate containing nothing but phenol and water. Similarly tribromophenol is not characteristic, except in smell, unless perfectly pure. The mercury test and the chloroform test do not apply to dilute solutions.

Having had occasion to detect phenol in soap, in which the proportion of phenol was not more than 0.01 p.c., I devised the following process, which can be carried out if necessary on the original without distillation. The reagent is paranitraniline hydrochloride, and is made up in the same way as "Reagent A" of my test for nitrous fumes (*This J.* IV., January, 1921, foot of page 5), viz., 1.5 grams paranitraniline base dissolved in 500 cc. of hot water with the aid of about 4 ccc. of strong hydrochloric acid.

For a test, the solution suspected of containing phenol is roughly neutralised if very acid or alkaline and treated with $\frac{1}{2}$ gram of sodium acetate. 5 cc. of the yellow paranitraniline reagent is taken and treated with dilute sodium nitrite solution (slowly) until it becomes colourless (but a moderate excess over this stage does not matter). The mix-

ture is then added to the suspected fluid, when a pale yellowish flesh-colour develops. An orange precipitate is obtained if much phenol is present. After waiting a minute excess of caustic soda is added when a deep colour is obtained, ruby-red if much phenol is present, rose-red if over 0.01 p.c., and salmon-coloured if only a few parts of phenol per million of fluid are present. The latter colour, if sufficiently dilute, shows in in the spectroscope a broad absorption-band at λ 494, whereby phenol may be distinguished from the cresols and other substances which give colours with the reagent. Even with the eye the distinction can be made, since the colours given by the cresols are rose-pink, and that given by naphthol, blue.

The phenol colour is due to nitrobenzene-azophenol, which in presence of caustic soda is ionised to $(O:C H_4:N_2:C H_4:NO_2)$ which is deeply coloured on account of its peculiar constitution.

It is probably safest in all cases where a doubtful colour has been obtained by the reagent, to distil the suspected liquid and repeat the test on the distillate: otherwise certain non-volatile phenolic substances such as tannin (which gives an inky colour with the reagent and caustic soda) may cause confusion.

Working with test-tube quantities and avoiding excess of the reagent, phenol in a dilution of one part per million can be detected.

The mixed (paranitraniline-nitrite) reagent keeps for quite a long time. It is, in fact, a trade article (for dyeing) in England, known by the various names: "nitrosamine-red," "nitrazol C," "azogen-red," "azophor-red," "benzonitrol," etc.

LITERARY INTELLIGENCE.

The following volumes will be published shortly:—

"The Colloid Chemistry of the Proteins." by Professor Wolfgang Pauli, translated by P. C. L. Thorne, M.A. There are 27 diagrams and numerous tables.

"The Principles of Radiography," by J. A. Crowther, Sc.D., F.Inst.P., University Lecturer in Physics applied to Medical Radiology, Cambridge. This volume contains 55 illustrations, and deals with the physical side of the subject.

By Messrs. J. & A. Churchill.

The Popular Chemical Dictionary (Second

By Messrs. Baillière, Tindall & Cox.

Edition), by C. T. Kingzett, F.I.C., F.C.S.

VITAMINS AND THE CHOICE OF FOOD.—Under the above title, Mrs. Violet G. Plummer, Associate of the Royal Sanitary Institute, and Dr. R. H. A. Plummer, Professor of Chemistry in the University of London at St. Thomas's Hospital Medical School, have written a book which is intended for the general reader, especially those who are responsible for the feeding of large numbers, such as the principals of schools and colleges. It should also interest medical practitioners and medical and agricultural students. It gives a short account of the medical and scientific investigations which preceded the recognition of vitamins and the need of these substances in nutrition.

Laboratory experiments on the feeding of animals with chemically pure foodstuffs led to the discovery that for the maintenance of life and health there must be present in the food small quantities of some unknown substances. These are called accessory food factors or vitamins. The existence of three distinct vitamins has been detected. It is shown that rickets and some other diseases are associated with a deficient supply of the A-vitamin; beri-beri is caused by the absence of the B-vitamin; and scurvy by the absence of the C-vitamin from the food. Many of the intestinal and other chronic disorders so common in civilised countries are traceable to the long continued use of food poor in vitamins. In large towns a relatively small amount of natural food-stuffs is now consumed. Many food-stuffs are subjected to commercial processes, such as machine-milling, refining, desiccation, sterilisation, etc., and are robbed thereby of these indispensable substances. Common errors in the selection and preparation of food-stuffs are pointed out. Tables, showing the distribution of the three vitamins in common food-stuffs are given, and should be of assistance to those who are responsible for the selection of food in schools and other large communities. The vitamin value of some common food-stuffs for cattle and poultry are included in the tables.

The significance of the *kind* of protein in the food is emphasised; the disease pellagra is caused by a diet containing protein derived almost entirely from the seeds of plants, with little or no animal flesh, milk, or eggs.

Throughout the book special attention is given to the vitamin requirements of the in-

fant and growing child. The problem of the marasmus infant is considered.

The volume, which will be illustrated, will shortly be published by Messrs. Longmans, Green & Co.

GENERAL NOTES.

Abstracts of Papers recently Published in the "Astrophysical Journal."

NYSWANDER, R. E., LIND, S. C., AND MOORE, R. B. The Spectrum of Radium Emanation. *Astrophysical Journal*, 54, 285-292, November, 1921. The University of Chicago Press, Chicago, Ill.

ABSTRACT.

Spectrum of RaEm, $\lambda\lambda$ 5982 to 7450.—Two capillary discharge tubes were filled with 0.2 and 1 curie of carefully purified emanation, respectively, and both visual and photographic measurements were made with a 4-prism spectrometer. The relative intensities of the lines differed markedly, as a rule, from the previous observations of Watson and Royds and Rutherford; many strong lines of the 120 previously measured were not found, and yet of the 44 lines obtained, 9 are new lines. Changes of intensity with duration of the discharge were noticed, some lines decreasing, some increasing in strength, while the colour of the discharge changed from a bright glow to violet. λ 5483 and some other lines flashed out on reversing the current after a thirty-minute run and then quickly disappeared.

Occlusion of RaEm in discharge tube.—After a discharge had passed through the glass capillary tube containing 0.2 curie for 5 hours, 35 per cent. of the emanation had been occluded, most of it in the platinum mirror surrounding the cathode. The other tube became quite hard after a four-hour run.

Modification of Duane's apparatus for purifying RaEm.—The copper wire used to remove oxygen and hydrogen is spirally wound on a silica tube and is heated indirectly by an electrically heated Pt wire passing through the tube, instead of directly by a current through the Cu wire. This arrangement requires less current and less attention.—GORDON S. FULCHER.

FABRY, CHARLES, AND BRISSON, H.—A Study of the Ultra-Violet End of the Solar Spectrum. *Astrophysical Journal*, 54, 297-322, December, 1921. The University of Chicago Press, Chicago, Ill.

ABSTRACT.

Solar spectrum from λ 3150 to λ 2900 A.—To obtain photographs of this region it is necessary to eliminate diffuse light of longer wave-length. This was done by using a double spectrograph consisting of two quartz spectrographs in series arranged with their dispersion planes at right angles. The intensity of the spectrum falls off very rapidly, being only one-millionth as great at λ 2900 as at λ 3150; therefore, to enable the whole region to be photographed at once for measurements of absorption, two absorption screens made by intensifying photographic films with HgCl_2 were used in echelon to reduce the intensity of λ 2900. To obtain a photographic map with uniform normal exposure throughout, two plates, each covering half the region, were exposed by moving a shutter by hand at proper predetermined rates across each spectrum. The wave-lengths will be published soon.

Absorption of the atmosphere for λ 3150 to λ 2900 A.—By comparing the intensities of spectrograms taken for various zenith angles, the coefficients for various wave-lengths were determined. The effect of molecular diffusion was corrected for by using the Rayleigh formula, and the effect of haze was eliminated by assuming it independent of wave-length. A comparison with the corresponding coefficients for ozone, previously determined by the authors, shows remarkable agreement, leaving no doubt that this absorption is due to ozone.

Ozone in the atmosphere is found to be equivalent to a layer about 3 mm. thick at atmospheric pressure. The daily values for May and June, 1920, vary irregularly from 0.29 to 0.34 cm. It would be interesting to follow these variations through a solar period. It is shown that the location of this ozone must be in the outer layers of the atmosphere, above 40 mi. and in explanation of its origin it is suggested that the ozone is produced by solar rays of wave-length shorter than λ 2000 which penetrate only the outer layers, and that longer rays dissociate the ozone and prevent its accumulation beyond the amount for equilibrium.

Distribution of energy in the solar spectrum outside our atmosphere for λ 3150 to λ 2900 A was determined by correcting the observed intensities for the absorption by

the atmosphere and then reducing to units of energy by the use of a calibration-curve obtained by comparing the intensity-curve of an arc with the radiation from a black body at 3750° Abs. The energy-curve thus obtained shows only a gradual slope toward the shorter wave-lengths. For λ 3143, λ 2997, λ 2922, and λ 2898 the relative energies for the sun outside the earth's atmosphere come out 155,000, 218,000, 145,000, and 45,000 respectively, while at the surface of the earth when the sun is at the zenith the corresponding values are about 22,400, 1320, 2.2, and 0.02. GORDON S. FULCHER.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 4835 Asheroff, E. A. Electrolysing fused salts of metals and recovering metals and acid radicles, etc. Feb. 18.
- 4435 Blanc, G. A. Method for separation of chlorides of aluminium and potassium present in mixed solutions obtained in the treatment of leucite. Feb. 15.
- 4437—Blanc, G.A.—Methods for treatment of alum to obtain sulphates of potassium with ammonium and free alumina. Feb. 15.
- 4492 Dehn, F. B.—Deriving hydrazobenzol, etc. Feb. 15.
- 4607—Hawthorn, E.—Process for purifying oils containing sulphur. Feb. 16.
- 4626—Imray, O. Y.—Manufacture of azo dye-stuffs. Feb. 16.

Specifications Published this Week.

- 174653—Naef, E. E.—Manufacture of sodium compounds and by-products.
- 154579—Wohl, A.—Production of aldehyde and acetic acid.
- 174784—Dawson, W. H.—Process for the Purification of anthraquinone.
- 156187—Chemische Fabriken Worms Akt Ges.—Process for regenerating metallic mercury.
- 174878—South Metropolitan Gas Co., Evans, E. V., Parrish, P., and Wight, O. W.—Manufacture of ammonium sulphate.

Abstract Published this Week.

Lithopone.—Patent No. 173,567. A new process for the manufacture of Lithopone has been in-

vented by Mr. J. L. Mitchell, of 17, West 108th street, New York, U.S.A.

The precipitate of barium sulphate and zinc sulphide is dried and pulverised and then calcined at a temperature of 700-950° C., with constant agitation, preferably with exclusion of air. The calcined product is quenched in water, dried, and re-grated. The calcining apparatus comprises a cylinder which is heated by gas-burners or other means, and contains an agitating-screw, the motion of which is periodically reversed automatically. The pulverised dried precipitate is fed through an admittance gate and doors, which prevent access of air to the furnace, and the discharge is conducted through outlet doors, a water-tough from which the quenched product is removed to the conveyor. The furnace and the delivery chamber are provided with water-sealed outlets for the escape of vapour.

Messrs. Warner & Co. will obtain printed copies of the published specifications and forward on post free, for the nominal price of 1/- each.

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97, SHOE LANE, LONDON, E.C.4.



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THE CHEMICAL NEWS,
97, SHOE LANE, LONDON, E.C.4.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3232.

GERMAN DYES.

In the House of Commons, on Monday, March 13, Mr. Baldwin informed Col. P. Williams that under the Reparation Clauses of the Treaty of Versailles, Germany accorded to the Allies certain options on the stocks of dyes in that country at a fixed date, and on the output for a period of five years which ran from Jan. 1st, 1920. Inasmuch as the second option was a continuing one, and the extent of which it was exercised and the prices of any dyestuffs taken must depend on current market conditions, it was impossible to form any estimate of the total value of the dyestuffs covered by the Treaty provisions. The fullest possible use was being made of those provisions, and the German obligations had been fully carried out: but there was no obligation on the German manufacturers to produce according to the requirements of the Allied countries. The quota which the Allies could take was strictly limited, and that quota had to be allocated between all the Allies. Consequently, it was necessary to supplement Reparation supplies by supplies from other sources, and for these licences were necessary.

The Central Importing Agency was under the control of the Board of Trade only in so far as it acted as the agent of the Board of Trade for the distribution of Reparation dyestuffs, for which it was remunerated on a commission basis. Separate accounts were kept of all the transactions of the agency in respect of such dyestuffs. The Board had no control over any other operations of the agency or over the appointment or remuneration of its staff.

Further questions have been asked in the House of Commons with regard to dyestuffs. Mr. Baldwin, President of the Board of Trade, in reply, stated that he understood that the Dyestuffs Development Committee was engaged in a very careful survey of the precise extent to which British manufacturers were in a position to meet the requirements of British consumers of dyestuffs, in order to ascertain as definitely as possible the directions in which it was of chief importance that production should be

tial to the proper consideration of the whole problem, was obviously a very difficult one, and it would not be right for him yet to ask the Committee for a report. The Committee consisted of three representatives of the dye-makers, five representatives of the dye-users, and three independent representatives. Four of the five representatives of the consumers had been appointed by the Board of Trade on the nomination of the Colour Users' Association, which comprised the great majority of the colour users. Should any members of the Association be dissatisfied with the proceedings of those representatives, it was, of course, open to them to take steps within the Association with the object of bringing about a change.

Mr. Baldwin added that he was aware that considerable stocks of German dyes were being carried by agents in this country. During the period in which there was no restriction on importation, quantities of dyestuffs greatly in excess of current trade requirements were imported by the agents, and the prolonged trade depression had no doubt very much delayed the liquidation of the stocks.

THE ATOMIC THEORY IN 1921.

(Continued from Last Week.)

Presidential Address, Section B., S. African Association for the Advancement of Science, Durban, by James Moir, M.A., D.Sc., F.R.S.S.A., F.I.C., F.C.S.,

The second point concerns Moseley's law, for the K-lines in X-ray spectra. The expression $1/\lambda = K(N-1)^2$ becomes $1/\lambda = K \cdot 2$ for lithium. If we make the simple assumption that H^+ is a nucleus and the only free nucleus known (omitting the products of radioactivity), hydrogen becomes an entity *sui generis*, and the first real ordinary atom is helium. Moseley's law then becomes $1/\lambda = K \cdot (N+1)^2$, in which N is zero for helium and is not the atomic number, but the number of *valency* electrons in the smaller elements. For higher elements N is the number of electrons outside the Kernel.

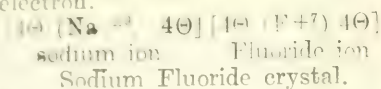
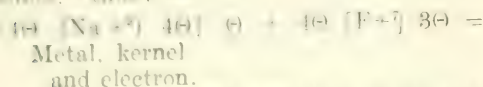
For the L series of lines in the higher elements it is possible that the law is that $1/\lambda$ varies as the square of the atomic weight (not number) counting neon as zero

number (i.e., subtracting 20), viz., $\lambda = C(A-20)$ instead of $\lambda = \frac{5}{27} K (N-7.4)^2$ as

given by Moseley.

Some account of Gilbert Lewis's octet theory (*J. Amer. Chem. Soc.*, 1916, 768), which is almost certainly true for the elements higher than oxygen, may now be given.

Fluoride, iron atom and sodium ion all have the same octet of electrons, but in *fluorine atom* one is missing, leaving a "hole." In *sodium metal* one is in excess. In sodium fluoride the extra electron of sodium metal fills the hole in the fluorine atom: both then become ions even in the crystal state, and both have complete octets, thus:—



Note—The expression Na^{+9} is really Na^{+11} , the atom having 2 inner electrons to make a kernel out of a nucleus (see page 4).

The fundamental conception might appear (reading Lewis strictly) to be that the same electron belongs to two atoms when a compound is formed, but undoubtedly in the *ionizable* compounds the metal electron is transferred and the residue, which is the metal ion, is quite independent, not only in solutions but in crystals, the atoms in which are simply held together because one ion is positive as a whole and the other negative as a whole. In the case of such a compound as chlorobenzene, however, the chlorine is completely un-ionised, and it is to be assumed that the chlorine is much closer to the rest of the molecule and has an electron in common with the carbon to which it is attached. The chlorine "shell" is a cube* and the carbon "shell" a tetrahedron, and the corner or point of junction is the same electron. Generally speaking, the conception is that when 8 electrons get established round a nucleus, the result is a saturated body which is incapable of further chemical action: it is only rendered active again by electrolysis or analogous processes.

There are great difficulties in accepting Gilbert Lewis's octet theory of valence for the lower elements, although it is probably true for the higher elements. The new suggestion I wish to bring forward is, as already said, that the arrangement or structure of the nucleus governs the structure of the valency electrons in the smaller atoms. The nucleus, although its actual weight has nothing to do with chemical properties, thus indirectly influences the direction in space of the valency electrons, and consequently affects the chemical properties of the atom by its *arrangement*, not by its size. Thus, to make my position quite clear, even at the risk of repetition, the arrangement of the carbon nucleus has the shape of a regular tetrahedron, that of the nitrogen-nucleus, the shape of a tetrahedron or pyramid with one point farther from the centre than the other three, and that of oxygen the shape of an irregular tetrahedron with two points nearer and two points farther from the centre. Each valency electron in the case of carbon has its average position in line with a projection of the nucleus, giving a regular tetrahedral result.

In nitrogen, 3 of the valency-electrons are arranged as in carbon, namely, in line (from the centre of the nucleus) with the 3 nuclear points which are nearer the centre: whilst the other two form a saturated pair lying opposite the fourth point of the nucleus where the group X + is attached to the nucleus. Putting Z for the arrangement of Fig. 6, X for that of Fig. 5, the carbon becomes $(Z_4 + 2\Theta)$, the carbon kernel becomes $(Z_4 + 2\Theta) 2\Theta$, and the carbon atom becomes $[(Z_4 + 2\Theta) 2\Theta + 4\Theta]$, the whole arrangement being tetrahedral. The nitrogen nucleus is $(Z_1 + 2\Theta + X)$ or $(Z_3 + 2\Theta + Z X)$; the nitrogen kernel has two more electrons, so that the nitrogen atom is $Z_1 X + 4\Theta$, or the carbon nucleus plus X plus 2 Θ .

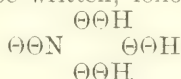
Nitrogen gas N_2 is thus of the same structure as acetylene, i.e., $\text{CX}:\text{CX}$, as compared with $\text{CH}:\text{CH}$; and the "metameric" gas carbon monoxide has the same external structure as nitrogen and acetylene, i.e., each atom having 5 electrons round it, of which two for a neutral pair. The ordinary notation of this formula would be $\text{C}:\text{O}$, which on my theory (and referring to the nuclei only) is $\text{C}:\text{CX}_2$.

This, of course, involves the actual transfer of an electron from the oxygen atom to the control of the carbon atom. This

* Or Sir J. J. Thomson's skew-cube ("skube").

theory explains well why the two gases are almost identical physically, whilst there are still two "shells" in agreement with the C_p/C_v ratio, which is violated by the Lewis-Langmuir theory of two nuclei inside one shell of electrons. The existence of nitric oxide in the form of NO instead of N_2O_2 is a stumbling block for all the existing theories of chemical affinity. The problem is analogous to the existence of free atoms in sodium vapour and hot iodine vapour. Probably the best provisional explanation on my theory is to formulate it like carbon monoxide, thus employing 10 of its 11 electrons, leaving the extra electron in an outside position similar to that of sodium metal.

The nature of ammonia gas and ammonium ion may next be discussed. The former may be written, following Lewis, as



which, having altogether 17 plus and 17 minus charges, is neutral. It has, however, at one end a free pair of electrons, and therefore has an affinity for hydrion, which can add on at that point, giving ammonium ion, a substance which has the same saturated tetrahedral configuration as methane, but has a total of 18 plus and 17 minus charges, and is therefore positively monovalent.

Ammonium chloride contains this ion, and the chloride ion existing side by side at some distance from each other, just as in sodium fluoride previously discussed. When the latter is electrolysed the fluoride ion loses an electron, whilst the sodium ion gains an electron and thus becomes metal. In the case of ammonium also, no doubt the metallic phase $(NH_4^{16+17}\Theta)\Theta$ must come into existence for a moment, but since the external electron must be near a group $\Theta\Theta H$, the result is dissociation into Θ and $(H^+\Theta)$,
(Θ)

i.e., into NH_3 gas and nascent hydrogen.

The nature of water and steam on this theory is worth notice. Following the analogy of ammonia as related to methane.

water (vapour) becomes $\Theta\Theta \quad \Theta\Theta H$ which
 $\Theta\Theta \quad \Theta\Theta H$

altogether has 18 plus and 18 minus charges, so is electrically neutral. It has

two pairs of electrons left free, and thus can combine either once or twice with hydrion, giving $(OH_3)^+$ and $(OH_4)^{++}$. Liquid water and ice are the hydrates of these complex ions, $(OH_3)^+$ and $(OH_4)^{++}$ being H_2O_2 , and H_6O_4 being $(OH_4)^{++} (OH_2)_2$. This theory accounts for the very low dissociation of water since owing to the combination, viz., $[OH_3^{19+16}\Theta] [OH_4^{17+18}\Theta]$ there is scarcely any free hydrion, the constitution being not unlike that of C_2H_6 . No doubt aqueous hydrochloric acid, when strong, contains $(OH_3)Cl$ and $(OH_4)Cl_2$. On this theory the angle between the two valencies of oxygen is not very different from that in the case of carbon. Hence H-O-H is misleading, and H_2O should be

printed $O \begin{array}{l} \nearrow H \\ \searrow H \end{array}$

Another spatial consideration is that NH_4 ion, owing to the fact that the tetrahedron of hydrogens which is attached to valency electrons is far out from the N atom, has an abnormally large volume (as compared with sodium). This agrees with the fact that ammonium and the large atom rubidium (weight 85) are mutually replaceable in crystals.

The conceptions for KNO_3 and $KClO_4$ are specially interesting. The NO_3 ion has 23 plus charges (3 sixes from oxygen and one 5 from nitrogen) and 24 binding electrons (3 octets): its valency is therefore -1, the same as that of fluoride ion (valency +7-8). Similarly the ClO_4 ion has $7 + (4 \times 6) = 31$ plus charges, and 32 binding electrons (4 octets), giving a total valency of -1 also: similarly SO_4 has 30 plus and 32 minus, giving a valency of -2; PO_4 similarly is 29 plus and 32 minus = -3. ||This paper would not be complete without some account of the nature of the spectrum lines of the elements. In the first place it is known that these lines, like the valency of the element, have their origin in the outermost electron-shell of the atom. The spectrum of hydrogen which by theory arises from a single electron has been already reduced to a mathematical formula, viz., $1/\lambda = 1097 (1_2 - 1_1)$ in which N is 1 - 1
2 N 2 N
successively 3, 4, 5, 6, etc. This is a harmonic series, beginning with λ 6563 (line C of the sun), and terminating by superposi-

tion at $1/\lambda = 1097 \frac{1}{N^2}$ or $\lambda = 3650$. Hydrogen has also an ultra-violet spectrum for which $1/\lambda = 1097 (1 - 1/N^2)$ and N is 2, 3, 4, ... successively.

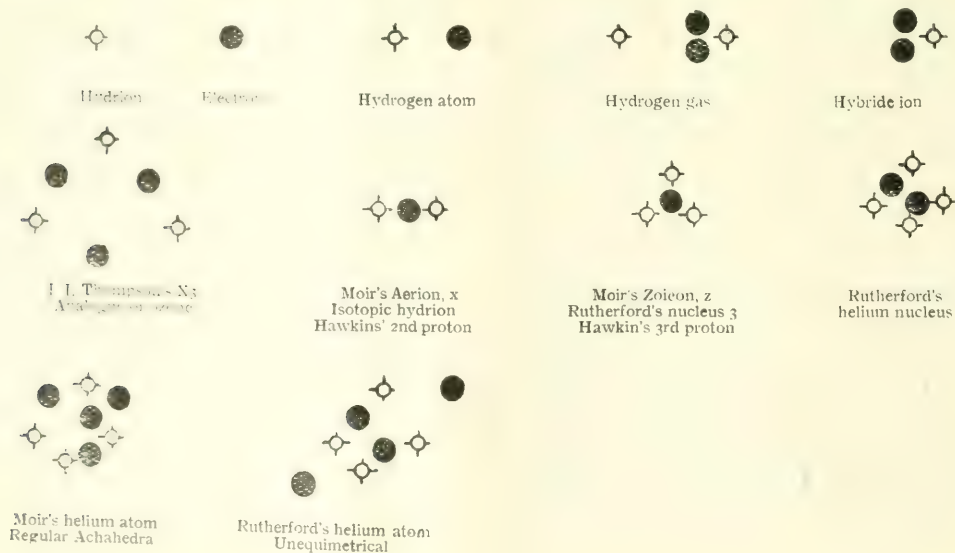
Similar, but more complex formula, also depending on inverse squares of natural numbers, hold for the other elements.

N. Bohr has suggested that the cause is revolution of the electron in a constant slightly-elliptic orbit round the nucleus, with the possibility of it suddenly jumping from one orbit to another, thus giving what is called a *quantum* of radiation. The mathematics of this *per-lun* theory lead not only to the above formula for the frequency of the different kinds of light emitted, but also predict the fine structure of the spectrum lines when seen under high resolution. Nevertheless Sir J. J. Thomson declares that when there are several electrons no stable orbit is possible, so he suggests that the electrons vibrate in and out instead of round, that the nucleus repels when the electron goes near and attracts when it is far, thus giving a neutral position where there is no force, which neutral position is that of the electron in the unstimulated atom. This theory also leads to the octet (skew-cube) arrangement when the number of electrons is large. Now in crystals it is known that there also resides a repulsive force preventing compression and varying as the inverse tenth-power of the distance, so we see that crystallography is being swallowed by Physics just as

Chemistry has been, and this unification of the Sciences is all to the good.

In conclusion, I have to apologise for being unable personally to represent some of the other Sciences comprised in Section B. I invite the attention, however, of the devotees of that non-experimental science (Geology, to the possibility that some of their cherished replacement theories may have to go to the wall—in other words that what appears to be replacement may be transmutation. Thus carbon appearing in silica is very easily explained if silicon nucleus is CHe , as I suggested in 1909. So if zirconium-nucleus is CNe , titanium $SiNe$ and niobium NNe , their genesis becomes easily understood. The pressures in the interior of the earth may be sufficient to overcome the repulsive force in the atoms (even though, as already said, it varies as $1/d^{10}$) and thus transmits them by simple squeezing. Such minerals as the trio $SrSO_4$, YPO_4 , and $ZrSiO_4$ could be changed into one another quite easily on this theory, by moving one or two hydrions only. When I have come across an ordinary geological theory, I have always felt like Cato "*Semper miror quod non rideat haruspex* haruspicum quum viderit.*" so when Geologists meet and see one another here in this section I hope they will take the hint and wink discreetly.

* In modern parlance "A Certificated Inspector of Entrails."



PROCEEDINGS AND NOTICE OF SOCIETIES.

THE ROYAL SOCIETY.

List of papers read on March 23rd, 1922:

SIR RICHARD GLAZEBROOK, F.R.S.—The Specific Heats of Air, Steam and Carbon Dioxide.

LORD RAYLEIGH, F.R.S.—A Photographic Spectrum of the Aurora of May 13th-15th, 1921, and Laboratory Studies in connection with it.

F. A. FREETH.—The System: $\text{Na}_2\text{-CO}_2\text{-NaCl-H}_2\text{O}$. Communicated by Prof. F. G. Donnan, F.R.S.

M. A. CATALAN.—Series and other Regularities in the Spectrum of Manganese. Communicated by Prof. A. Fowler, F.R.S.

D. W. DYE, B.Sc.—Calculation of a Primary Standard of Mutual Inductance of the Campbell Type, and Comparison of it with the similar N.P.L. Standard. Communicated by Sir J. Petavel, F.R.S.

P. E. SHAW and N. DAVY.—The Effect of Temperature on Gravitational Attraction. Communicated by Prof. E. H. Barton, F.R.S.

ORDINARY MEETING, MARCH 9, 1922.—Sir Charles Sherrington (*President*), in the chair.—The Bakerian Lecture was delivered by Prof. T. R. Merton, F.R.S., and Mr. S. Barratt on "The Spectrum of Hydrogen."

Summary:—

The Balmer series and the secondary spectrum of hydrogen differ in the conditions most favourable for their production, the secondary spectrum being characteristic of pure hydrogen and feeble discharges. Impurities weaken the secondary spectrum and enhance the Balmer series. Owing to the enormous number of secondary lines, regularities are hard to recognise, but the lines can be classified in different physically related groups under different conditions, depending on the pressure of gas in the discharge tube, the conditions of excitation, &c. The secondary spectrum is modified in a striking manner by admixture of helium with the hydrogen.

These methods of classification are compared with the regularities discovered by Fulcher and investigations of the Zeeman effect. The Balmer series appear in most celestial spectra. There is no evidence that lines of the secondary spectrum are present

in the solar spectrum. There has been some doubt whether the secondary spectrum is due to the atom or the molecule. Measurements of the widths of the lines by a new method which is independent of estimates of "limiting visibility" show that the secondary spectrum is due to the molecule. There is reason to suppose that determinations of the wave-lengths of lines of spectra, other than those from gases at low pressure and excited by uncondensed discharges, may be subject to a serious source of error, and the reality of certain changes of wave-length of spectrum lines may perhaps be suspected.

There is evidence that when the current density of electrical discharges through vacuum tubes is great a partial separation of the gases contained in the tubes may be effected. A number of phenomena are considered in relation to this effect, which may perhaps have some bearing on the interpretation of certain celestial spectra. There is much evidence for a specific influence of neighbouring atoms on the spectra emitted. The effect of helium on the secondary spectrum of hydrogen is not unique, and a particularly striking case is found in its effect on the spectra associated with carbon. A study of the broadening of spectrum lines also leads to the conclusion that there is a specific influence of neighbouring atoms.

GEOLOGICAL SOCIETY OF LONDON.

Report of Annual General Meeting, held February 17, 1921, the President, Mr. R. D. Oldham, F.R.S., in the chair.

(Continued from last week.)

In presenting the balance of the proceeds of the Murchison Geological Fund to Herbert Bolton, M.Sc., the President addressed him in the following words:—

MR. BOLTON,—

The Council has awarded to you the balance of the Murchison Fund, in recognition of your contributions to our knowledge of the stratigraphy and fauna of the Carboniferous System and of your continued and successful conduct of one of the most progressive of our provincial museums. As an authority on the insects of the Carboniferous Period, you are conspicuous. The results of your labours, in the rescue, preservation, and description of these relics of a long-bygone past, have proved of supreme interest in establishing the great antiquity

of some of the common insect-types of the present day. Added to this, your studies of the faunal stratigraphy of the Carboniferous rocks of the Bristol coalfield have been of value, which has led to their publication in our Quarterly Journal. For these reasons the Council has made this award to you, in recognition of the work which you have done in the past, and as an encouragement to others to emulate your example.

The President then handed the balance of the proceeds of the Lyell Geological Fund, awarded to Mr. Arthur Macconochie and to Mr. David Tait, to Dr. J. S. Flett for transmission to the recipients, addressing himself as follows:

DR. FLETT,—

The balance of the Lyell Fund has been awarded in two moieties to Mr. A. Macconochie and Mr. David Tait, in recognition of their joint and individual contributions to the advancement of geology. During his service as fossil-collector on the Geological Survey of Scotland, Mr. Macconochie was the discoverer of one of the most notable fossil localities in Scotland, where, at Glen-cartholm in Dumfriesshire, he found, in Lower Carboniferous shales, a large number of new genera and species of plants, crustaceans, fishes, and land animals, and was the discoverer of the *Olenellus* fauna in the North-West Highlands, a discovery which caused the renaming of two of the rock-groups of that region. Conjointly with Mr. Tait he collected a new fish-fauna from the Downtonian rocks of Lanarkshire, which, in the words of Dr. R. H. Traquair, opened out a new vista in the field of Palæozoic ichthyology. Mr. Tait, by his investigation of the Rhynie chert-band, was able to establish conclusively its true age as Old Red, and the investigation of his collections has thrown much light on the problems connected with this oldest land-flora. I have referred briefly to the more outstanding of their individual contributions to knowledge, made during a long and devoted service, which has yielded a large body of material for detailed investigation by others. In recognition of this, I ask you to accept and transmit these awards to their respective recipients in the name of the Geological Society of London.

The subject of the Presidential Address was the Cause and Character of Earthquakes, using the word in its original sense of the disturbance which can be felt and, when severe, causes damage, as apart from

that which gives rise to distant records, only obtainable by special instruments. The character is sufficiently established as a form of elastic wave-motion, of extreme complexity; this is present in all cases, and may be distinguished as the orchesis of the earthquake. In addition there is, in some cases, a molar, permanent, displacement of the solid rock, which forms the mocheleusis. Further, it has been shown, definitely in one case and inferentially in others, that, where mocheleusis is present, the disturbance of the surface-rocks, to which the earthquake proper can be referred, is only the secondary result of a more deep-seated disturbance, which has been distinguished as the bathyseism. The origin of the elastic wave-motion must be a sudden disturbance of some sort; the depth of origin can, in many cases, be shown to be very moderate, not more than about 10 miles, and in this outer portion of the Earth's crust the only sudden disturbance conceivable is fracture, due to strain in excess of the power of resistance. In certain cases such fracture, accompanied or not by displacement, has been recognised at the surface; and measurements of the displacements show that a state of strain must have existed before actual rupture took place, but give no indication of the rate of growth of the strain. The commonly-accepted notion that the growth must be very slow appears to depend on the assumption that the strain is due to the same causes as those that have produced the folding and faulting of the surface-rocks, and also on the assumption that tectonic, as other geological processes, must necessarily be slow. The problem can only be attacked through the variation in the frequency of earthquakes; the precautions needed in applying this method are indicated, and, when applied, leave only one existing record available, the Italian one. A discussion of this shows that the rate of growth of strain is, at slowest, such that the breaking-point will, on the average, be reached in, at most, a year, and, at the quickest, may be of such rapidity as to be analogous to a separate explosion for each earthquake. The possibility of so rapid a growth of strain being due to tectonic processes, as ordinarily understood, is considered and rejected, so that the changes by which the strain is produced must be referred to the material below the crust. Recent researches on the change of bulk, resulting from a change in the mineral aggregation of the same material, are re-

ferred to as indicating one means by which the required effect may be brought about; and, without restricting the possibilities of other unknown processes, the results are summarised as indicating that the cause of the great majority of earthquakes is a rapid growth of strain, and that the production of this strain must be referred to changes which take place in the material underlying the outer crust of solid rock, which is directly accessible to geological observation.

THE INSTITUTION OF ELECTRICAL ENGINEERS

MEETINGS—SUPPLEMENTARY INFORMATION.
—*Thursday, 23rd March, 1922 (6 p.m.)*
Discussion on the draft B.E.S.A. Specifications for Motor Starters.

Immediately after the conclusion of the Special General Meeting of Corporate Members to be held on the 23rd inst., to make Bye-laws for the Chartered Institution, the discussion on the draft Motor Starter Specifications of the B.E.S.A. (which was begun at the meeting held on the 2nd inst.) will be continued.

A limited number of copies of the draft Specifications may be obtained from the Secretary, who will also be glad to receive the names of those desirous of taking part in the discussion.

Thursday, 30th March, 1922 (6 p.m.):
Paper by Mr. R. Borlase Matthews on "Applications of Electricity to Agriculture." This paper will be illustrated by a cinematograph film.

Thursday, 18th May, 1922 (6 p.m.): The Thirteenth Kelvin Lecture by Professor Sir Ernest Rutherford, K.B.E., F.R.S., on "Electricity and Matter." Attention is drawn to the change of date (18th May, instead of 11th May).

ROYAL INSTITUTION OF GREAT BRITAIN.—*Albemarle Street, Piccadilly, W.1.*—The Friday evening Discourse next week (March 24, at 9 o'clock), will be delivered by Professor F. G. Donnan, C.B.E., D.Sc., F.R.S., M.R.I. The subject is "Auxiliary International Languages." Saturday, March 25: Sir Ernest Rutherford, LL.D., D.Sc., F.R.S., M.R.I., Professor of Natural Philosophy, R.I., on "Radio-activity." (Lecture IV.)

ROYAL SOCIETY OF ARTS.—*John Street, Adelphi, London, W.C.2.*—The second Canton Lecture on the Constituents of Essential Oils, by L. Guy Radcliffe, M.Sc.Tech.,

F.I.C., will be given on March 27, at 8 o'clock.

The subject will be: The Classification of the Constituents of Essential Oils. The Cyclic and Olefinic Terpenes and their more important Derivatives.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

SUMMER MEETING AT SCOTTISH CENTRE, 30 MAY—2 JUNE, 1922.

A Summer Meeting of the Institution will be held at the Scottish Centre during the above period.

Ladies are cordially invited to take part in the Meeting.

The programme is substantially the same as that of the Meeting arranged for last year (abandoned on account of the coal strike), and is as follows:—

TUESDAY, 30TH MAY.—Morning: Visit to Dalmarnock Generating Station, preceded by a paper (at the Royal Technical College) by Mr. R. B. Mitchell, on the Dalmarnock Generating Station. Lunch at Municipal Buildings by invitation of the Corporation of Glasgow. Afternoon: Visits to John Brown & Co., Ltd., shipyard, Clydebank, the Clydes Mill Power Station of the Clyde Valley Electrical Power Co., and to other works, and a circular excursion by road to some of the Glasgow Corporation Reservoirs. Evening: Reception at the Municipal Buildings by the Corporation of Glasgow. Dance (Evening dress).

WEDNESDAY, 31ST MAY.—Morning: Paper at Glasgow University by Professor Mangus Maclean on "The Hydro-Electric Resources of the Scottish Highlands." Afternoon: Visit to Messrs. Babcock & Wilcox's Works, Renfrew. Afternoon and evening steamer excursion on Firth of Clyde by invitation of Messrs. Babcock & Wilcox.

THURSDAY, 1ST JUNE (West Highland Excursion).—Morning: Leave Glasgow for Fort William at 10.30 a.m. by special train; break journey at Tulloch Station (where picnic lunch will be provided) to view source of supply, Lochaber Waterpower Scheme. Arrive at Fort William evening and sleep there.

FRIDAY, 2ND JUNE (West Highland Excursion).—Morning: Special steamer to Kinlochleven, arriving about mid-day. Visit to the British Aluminium Company's Hydro-Electric Installation. Afternoon: Return by steamer to Oban. Hotel at Oban. End of Meeting.

CHEMICAL NOTICES FROM FOREIGN SOURCES

ROLE OF GASEOUS IMPURITIES IN THE CATALYTIC OXIDATION OF GASEOUS AMMONIA: INFLUENCE OF PHOSPHORETTED HYDROGEN

E. Debré.—The author has already shown that acetylene and sulphuretted hydrogen retard the catalytic oxidation of ammonia in presence of platinum. He has further found that even the minutest traces of phosphoretted hydrogen act as a poison, and 0.00002 per cent. of PH_3 is almost as toxic as 2 per cent. of H_2S . But as with H_2S the lowering of the yield only lasts as long as the impurity is present, which is not the case with C_2H_2 .—(*Comptes Rendus, CLXXIV*, No. 7, 1922).

MIXED ORGANOMETALLIC COMPOUND OF ALUMINIUM—*F. Thomus.*

When aluminium is left for a long time in contact with methylene iodide in the absence of any solvent, a reaction occurs without liberation of any gas, and a white crystalline substance is obtained which very readily reacts with most reagents. With nitrobenzene it is very rapidly decomposed, and iodine vapour is given off. When the reaction occurs in presence of anhydrous ether, it is found that approximately one atom of aluminium reacts with one molecule of methylene iodide. When about 1.5 gr. of the metal and 12 gr. of the iodide are brought together, about 90 cc. of a gas are evolved. This gas is absorbed by bromine and attacked by permanganate, and its formula is $(\text{CH}_2)_n$, but it cannot be identified with ethylene. By combustion in a eudiometer it is found that n is about equal to 3. The compound obtained in presence of ether is very active chemically, and reacts with acetyl chloride with evolution of much heat. It appears that other metals besides aluminium, for example lead, can attack methylene iodide in absence of any solvent, with evolution of considerable quantities of gas.—(*Comptes Rendus, CLXXIV*, No. 7, 1922).

NEW METHOD OF PREPARING CYCLIC AMINES—*Alphonse Muller.*

When aniline is directly hydrogenated over divided nickel a mixture of three amines is obtained, cyclohexylamine, diethylcyclohexylamine, and cyclohexylaniline. Metatoluidine is hydrogenated less easily, three distinct products, one of which is hexahydrometatoluidine, being obtained. The author has found that the hydrogenation of the three methylecyclo-

hexanoneoximes over nickel gives mixtures of primary and secondary amines, but the yield is low owing to the occurrence of secondary reactions. He has also prepared the cyclic amines by the hydrogenation of the ketazines and of cyclic ketones, for example, orthomethylcyclohexylamine and metamethylcyclohexylamine. The yields of the primary amines obtained by this method are much higher than those of the secondary amines.—(*Comptes Rendus, CLXXIV*, No. 7, 1922).

PREPARATION OF FATTY ACIDS FROM HYDROCARBONS—*M. E. DeFrance.*

Oleic acid has been synthesised starting with acetylene, the hydration of which gives aldehyde, from which a mixture of alcohols of high molecular weight is obtained by a series of condensations. These alcohols can be converted into the corresponding acids by oxidation. It does not appear probable that these processes can ever be applied on a large scale. By the method of Zelinsky, the paraffins can be converted into acids; they must first be chlorinated in the α position, and the chloride thus obtained is subjected to Grignard's reaction. The action of CO_2 upon the organometallic derivative thus formed leads directly to the formation of the acid. This method is also a laboratory method only, and is not likely to be extended to commercial applications. The hydrocarbons can be directly oxidised by means of ozone, but this is very expensive to make. There are many problems to be solved with reference to the oxidation of the paraffins. For example, very great differences of yield are obtained, and no precise information is to be obtained as to the occurrence of particular hydrocarbons in the different fractions of the mineral oils. The special reactions of each of these hydrocarbons are hardly known, and no studies have been made as to the influence of various factors—pressure, temperature, catalysts, alkalinity, etc., in the oxidation of each compound. The synthetic fats can be prepared by the etherification of the fatty acids with glycerine, but the great variety of the mixture which constitute the natural fats makes it very difficult to reproduce them artificially. Lapworth has recently prepared a dioleate of mannite, and it is possible that fats of physiological importance may be similarly obtained.—(*Journ. de Pharmacie de Belgique, LV*, 1922, No. 10).

NOTES ON BOOKS.

A Textbook of Assaying for the use of those connected with mines, by C. & J. J. BERINGER, revised by H. R. BERINGER, with diagrams and tables. 15th edition revised. xvi. plus 417 pp. CHARLES GRIFFIN & Co., LTD., Exeter St., Strand. Price 12/6.

The fact that 15 editions of the above work have appeared since its first publication in 1889 shows that it has been appreciated among students and those engaged in metallurgy. The work deals very exhaustively with the subject, presenting it in such a way as to meet the requirements of the student. The operations of sampling, choice of laboratory books, determination of moisture and similar matters, are treated in an introduction, which is followed by a good description of the dry and wet methods of assaying. The first 8 chapters deal with methods of manipulation, and in Part 2, Chap. 9, the detection and assay of silver and gold are given in detail.

The description of the metallurgy of Titanium, Tungsten, Niobium and Tantalum has been brought up to date, and a chapter is devoted to the alkaline earths. The six appendices that have been introduced into the various editions have been included. The book is thoroughly well illustrated, and will undoubtedly remain as a standard textbook on the subject for some time to come.

It is not possible to refer in detail to the mass of information included in the work.

We cannot help thinking, however, that some of the sections, particularly that referring to the alkaline earths, are still in need of revision. For instance, the extremely important oxide Thoria is very briefly touched upon, and nothing is said about its value as a means of illumination, while the next earth referred to, Zirconia, is said to be used for incandescent lights. Although this, of course, is perfectly correct, the importance of zirconia as an illuminant is insignificant as compared with that of thoria. Also the paragraph dealing with Lanthanum and Didymium seems a little out of date, as the latter body is described as though it were an elementary substance, no reference being made to its resolution into praseo- and neo-dymium by Auer von Wellsbach in 1880.

The Failure of Metals under Internal and prolonged stress.—A general discussion held by the Faraday and other societies in April, 1921, at the Hall of the Institution of Engineers.

Following the official business of the meeting, the President of the Faraday Society, Professor Alfred W. Porter, F.R.S., called upon Dr. W. Rosenhain to give his introductory address upon the failure of metals under internal and prolonged stress. Dr. Rosenhain, whose work upon this and kindred subjects is very well known, dealt exhaustively with the matter, and illustrated his remarks by a number of photomicrographs, some of which are reproduced. A number of papers were contributed, both of a general character and of specific cases of failure in steel and brass. The papers were followed by important general discussions, which are given in detail. The work is edited by Mr. Spiers, O.B.E., B.Sc., and is illustrated by many photographic reproductions. It cannot fail to be of value to all interested in metallurgical operations.

The Report, in book form, bound in cloth, is published by the Faraday Society, Essex Street, London, W.C. Price 10/6 net.

A Course of Practical Organic Chemistry, by T. SLATER PRICE, O.B.E., D.Sc., Ph.D., F.I.C., and DOUGLAS F. TWISS, D.Sc., F.I.C.: pp. xiv plus 239. London: LONGMANS, GREEN & Co., 1922. Price 6/6.

This textbook of practical organic chemistry has now reached its 3rd edition. The subject matter includes directions for the preparation of typical organic compounds, experiments to be carried out illustrating the properties of these, schemes for qualitative analysis, and the usual methods of quantitative analysis and determinations of molecular weight and formulæ are described.

This edition contains few alterations from the last, the most important being that the Grignard reaction is utilised to prepare benzoic acid, instead of the less well-known benzhydrol.

Two schemes of qualitative analysis are given. The first one appears at the end of the section on Aliphatic Compounds, and is suitable for the identification of about 40 substances and their derivatives.

The second scheme can be used for iden-

tifying the common aromatic bodies and their derivatives as well as for the aliphatic substances previously mentioned.

The chapters dealing with quantitative estimations are the best feature of the book. They are clearly written, and students will experience little difficulty in following the instructions given.

Except for the arrangement there is little that has not appeared previously in other textbooks on this subject.

The authors would greatly add to the value of this book if, in the next edition, they extensively alter the particular substances selected for the preparation of typical organic compounds.

Laboratory Exercises in Applied Chemistry, by Dr. W. MOLDENHAUER. Authorised Translation by LAWRENCE BRADSHAW, D.Sc., Ph.D.; pp. xii. plus 236. London: CONSTABLE & Co., LTD., 1921.

Dr. Moldenhauer's book has been written for students who are following a course of technical analysis. It comprises practically all the exercises conducted at the Darmstadt Technical College.

The translator has omitted most matter of purely local interest, but wisely retains the chapter dealing with the analysis of the crude and refined products from the Stassfurt Potash Mines.

Most of the analytical methods are well known, but a few are not those usually taught in our technical colleges and institutes. Among these is Ledebur's method for estimating phosphorus (page 157) and the apparatus figured on page 215 for the determination of the flash point of an oil has been considerably improved upon in this country.

In technical analysis, the rapidity with which a determination can be made is the prime factor. Consequently volumetric methods are chosen wherever possible, when they give sufficiently accurate results. The author evidently has this in his mind, since he even includes among these, Müller's Benzidine hydrochloride method for the estimation of sulphuric acid, present in salts as neutral sulphate.

An error has crept in on page 171, where brass is described as an alloy of zinc and tin.

The book can be safely recommended to the students for whom it is written.

Aluminium and its Alloys, by LT.-COL. C. GRARD. Translated by C. M. PHILLIPS, B.A. (Cantab), A.I.C.; pp. xxiv. plus 184 plus 17 plates. London: CONSTABLE & Co., LTD., 1921. Price 17/6 net.

Col. Grard has written this volume from the aeronautical viewpoint. Consequently he confines himself to the metallurgical and mechanical studies of aluminium and its alloys, with special reference to their industrial applications.

Much useful information has been collected, chiefly from French sources, which is of interest to physicists and to those engaged in various branches of engineering. The mechanical properties of the metal and its principal alloys are fully treated. Numerous photo-micrographs illustrate the effects of various treatments, such as cold-working, annealing, forging, etc. All this is of considerable importance, since, as the author shows, such treatments cause great variations in mechanical properties, such as tensile strength, elasticity, shock resistance, and hardness.

"Duralumin," the light alloy of great strength, contains from 3.5 to 4 per cent. of copper, and is obtained in the optimum final state by double quenching, showing maximum tensile strength, elasticity and percentage elongation.

Various magnalium alloys containing from 5 to 25 per cent. of magnesium show increased hardness, but are difficult to roll. It is of interest to note that parts of the Zeppelin brought down at Bourbonne were made of similar material of density 1.8.

The appendices retained by the translators contain analytical notes; extracts from French Aeronautical Specifications; and Reports of Tests conducted in certain French Technical Laboratories.

The book should be read by all concerned with the industrial applications of this metal.

Atomic Theories, by F. H. LORING; pp. x. plus 218. London: METHUEN & Co., LTD., 1921. Price 12/6 net.

The last decade of the nineteenth century witnessed the beginning of extensive experimental work and theoretical deductions in connection with the Structure of the Atom.

Mr. Loring has performed the difficult task of collecting and correlating the main conclusions arrived at from the numerous researches and speculations of many distin-

guished physicists and chemists. He has obtained his material from the original communications scattered among the various periodicals and journals of scientific societies, and includes some of his own contributions in the *Chemical News*. The most recent work has been incorporated in the book which is thus thoroughly up to date.

An adequate account is given of each of the numerous theories regarding the structure and nature of the atom. Wherever necessary the author has preceded the discussion of a theory by introductory notes bearing upon the significance of the experimental evidence. This is invaluable for students and those who are not thoroughly acquainted with the recent rapid strides of physics and physical chemistry in the realms of X-ray analysis, crystal-structure, radio-active disintegration, etc.

Rutherford's Nuclear Theory of the Atom together with the experimental evidence on which it is based is given prominence.

Langmuir's Octet Theory of Valence has received much attention since it was advanced three years ago, and his views on the arrangement of the electrons in the atom are quoted and merit careful consideration. Mr. Loring also deals with Sir J. J. Thomson's views on matter, mass and radiation, and with Aston's work on the mass spectra of atoms.

That the author has experienced difficulty in arranging the subject is evidenced by the fact that no less than eight appendices are given. Although most of these are mathematical and statistical, one is devoted to the Rutherford-Boddy Disintegration Law, and another to a useful explanation of the exact nature of the molecule.

Altogether this account of the recent experimental and theoretical investigations on the atom should appeal, not only to students of physics and chemistry, but also to those engaged in the various branches of mechanics and engineering. It can be confidently recommended to all interested in this important subject.

ROYAL INSTITUTION. . . On Thursday (March 30) Professor A. M. Hind delivers the first of two lectures on "Landscape Etchers: New and Old." The Friday Evening Discourse on March 31st will be delivered by Mr. A. B. Walkley, on "Jane Austen"; and on April 7, by Sir Ernest Rutherford, on the "Evolution of the Elements."

GENERAL NOTES.

The *Manchester Guardian Commercial* recently contained an important article on paper-making, in which Mr. Frederick Kaye, the discoverer of the rubber latex process, discusses the possibilities of the new methods:—"By using very strong fibres, such as Manila Hemp, Sisal Hemp, Jute, etc., and using higher percentages of rubber, say, up to 20 per cent. and more, products can be made on the paper-making machine to take the place of leather for many purposes. Such products can, necessary, be vulcanised by any suitable method. By using mechanical wood, waste paper, and various other fibres, with loading materials, and increasing the quantity of rubber latex used, linoleum-like products can be cheaply and abundantly made on a paper-making machine. These goods will be waterproof and very resisting to abrasions due to constant hard wear. By mechanical devices now being perfected, it will be possible to make these goods with beautifully coloured designs inlaid in the materials. Experiments show that many kinds of asbestos goods now made from Asbestos, such as high-pressure packing, can be made by the use of rubber latex. The latices of kutta-percha and balata can be used in the manufacture of paper and other goods to contain these natural products for the specific purposes for which their properties make them so valuable. Experiments on a commercial scale have already been conducted successfully in paper mills, and arrangements have been made for further commercial tests as to the production of latex paper in different paper mills in Lancashire, Yorkshire, the Midlands, London and the South. When these have been proved satisfactory, arrangements will be made to import larger supplies of latex for the use in the paper industry."

MORPHIA LICENCES.—Mr. Short, the Home Secretary, in reply to a question, said that the form of licence issued under the Dangerous Drugs Act, 1920, permitting the manufacture of morphia in Great Britain, was an authorisation to carry on the manufacture of morphine at certain premises specified in the licence and subject to certain conditions. The conditions were not necessarily the same in each case, but, in general, they provided for adequate supervision, exclusive of unauthorised persons, keeping of records of production and the like. The number of firms and pre-

ving the common aromatic bodies and their derivatives as well as for the aliphatic substances previously mentioned.

The chapters dealing with quantitative estimations are the best feature of the book. They are clearly written, and students will experience little difficulty in following the instructions given.

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gushed physicists and chemists. It has obtained his material from the original communications, scattered among the various periodicals and papers of scientific societies, and includes pages of his own contributions in the *Chemical News*. The most recent work has been incorporated in the book which is thus thoroughly up to date.

An adequate account is given of all of the numerous theories regarding the structure and nature of the atom. It is necessary the author has proceeded to discussion of a theory by which the atom is being built up on the significance of the experimental evidence. This is a valuable book for students and those who are not thoroughly acquainted with the recent work in the fields of physics and physical chemistry. It is the result of a very methodical arrangement of radioactive disintegrations, etc.

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Langmuir's *Valent Theory* of atoms has received much attention since it was advanced three years ago, and his views on the arrangement of the electrons in the atom are quoted and used as a basis for discussion. Mr. Loring also deals with the Thomson's ideas on matter, quantum radiation, and with Aston's work on the masses of atoms.

That the author has succeeded admirably in arranging the material is shown by the fact that no less than 100 pages of ideas are given. Although some of the ideas are mathematical and statistical, they are devoted to the Rutherford model, the Integration Law, and similar results in explanation of the exact nature of the atom.

Altogether this account of the modern experimental and theoretical knowledge of the atom should appeal to all students of physics and chemistry, but especially those engaged in the various branches of mechanics and engineering. It can be confidently recommended to all interested in this important subject.

ROYAL INSTITUTE.—The Thursday (March 30) Professor A. M. Ramsdell is the first of two lectures on "Landscapes: New and Old." The 11th Evening Discourse on March 31st delivered by Mr. A. R. Walker on "Austin," and on April 7, by Mr. Rutherford on the "Evolution of Elements."

GENERAL NOTES.

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MORPHINE LICENSE.—Mr. Stuart, the Home Secretary, in reply to a question, said that the form of licence issued under the Dangerous Drugs Act, 1920, permitting the use of morphine in Great Britain, is as follows:—

mises licensed was three. The amount of British-made morphia exported during 1921 as shown in the Customs returns, was 81,098 ounces, but this did not include the amount exported through the parcel post. The total amount of morphia licensed for export including export by post, was 112,681 ounces. Morphia was exported to all parts of the world, but over one-half of the amount shown in the Customs returns went to France. Other countries which received more than 5,000 ounces were Sweden, Belgium, and Canada.

POISON FOR CRIMINAL PURPOSES.—Mr. Shortt, Home Secretary, in answer to Sir R. Clough, said he believed that the use of poison for a criminal purpose had always been of rare occurrence in this country, and notwithstanding two or three recent cases, he did not think it could be alleged that it had become commoner than it used to be. He doubted if it was possible by law to ensure that there would be no improper sales, especially in the case of poisonous substances that were commonly used for legitimate purposes, but the matter was receiving consideration.

THE SCIENCE ASSOCIATION, MAHARAJAH'S COLLEGE, VIZIANAGRAM.—We have received from Madras, India, an account of the first anniversary meeting of the above institution. The proceedings were opened by Mr. C. V. H. Row, M.A., Professor of Mathematics at Lahore. His Highness the Yuvorajah Sahib of Vizianagram was present.

The objects and work of the Association were explained by the chairman. During the session popular lectures had been given upon chemical, physical, astronomical and other subjects, and a number of original communications had been read before the Society. Among them are two by Mr. Y. Venatramaiya, upon active hydrogen and the activation of hydrogen by the silent electric discharge. One of these papers has already appeared in "Nature," but we have been asked to reproduce them both.

As the subject of active nitrogen has recently been exhaustively investigated by Lord Rayleigh, the experiments by Dr. Venkatramaiya are of considerable interest. The other papers enumerated we are unfortunately not able to reproduce.

At the conclusion of the meeting, the Yuvorajah Sahib expressed his desire to

promote the pursuit of scientific knowledge and to become the patron of the Association, who would always find in him one who would be ready to help and assist in every way.

REFRACTORIES AND RESEARCH.—Before the members of the Midland Junior Gas Engineers on Thursday, March 16, Mr. T. F. E. Rhead, M.Sc., chief chemist to the Birmingham Corporation Gas Dept. (Central Laboratories, Nechells Works), read a paper on the chemistry and physics of gas works refractories. As to the use of grog in brick manufacture, he pointed out that the quantity of grog that could be added was limited by the fact that it reduced the strength of the refractory. Generally speaking the best grog to be used was that made from the clay from which the article was being made, after the clay had been burned a sufficient length of time to take out all the fire shrinkage. Firebrick should be burned at a finishing temperature of not lower than Cone 14, 1410° C., or higher, but many manufacturers did not go so high owing to the increased cost of production involved by the use of more fuel. The goods should be fired at a higher temperature than that they would attain when in use. Under steaming conditions on vertical gas retorts, it was possible that the coal ash had increased opportunity of attacking retort walls, partly due to the thinner scale, and partly due to exposure of the ash as the carbon was consumed by the steam. A similar effect was obtained in water gas generators where slagging action on the refractories was a serious item. The manufacturers' difficulty was that while a close-grained texture was best for overcoming those troubles, a coarse-grained texture was necessary to enable the material to stand temperature changes.

Mr. Rhead added that whilst testing refractories he had been very much impressed with the variations in quality of material supposed to be of uniform grade, and the necessity of both user and maker paying far greater attention to the quality of refractories could not be too strongly urged. Seeing the extensive use the gas, metal and pottery industries made of refractories, and the serious results which occurred if they broke down, there seemed every argument for that suggestion being more generally adopted. The number of gas works, however, that bought their material to specification, and what was more important, see-

ing that it was up to specification by carefully testing it, was decidedly small. Similarly, apart from a few enlightened manufacturers, very real testing was carried on by the makers. Central testing laboratories were needed. The variations in the quality of the raw material was much greater than was commonly recognised, and this was one factor which called for very careful watching and continuous testing and supervision on the part of the manufacturer. Well-informed technical control required to be started in the mine or quarry, just as in analysing a substance the sampling had to be most carefully and intelligently done, otherwise the result was useless. The Refractories Specification of 1911 was a big step forward, but it was very badly in need of revision in the light of knowledge and experience accumulated since then. With a revised specification reasonably to meet all present day requirements, and gas engineers buying to that specification, much better or more uniform material would doubtlessly result. It was, however, only fair to add in what pretends to be an unbiassed opinion on the subject of quality of refractories, that scientific men had still a great deal to discover about refractories—but surely that showed the urgent need for increased research on the lines of the invaluable fundamental work being carried on at Stoke, Leeds, and elsewhere. There were possibilities of great advances being made in the manufacture and proper use of refractories, as well as the introduction of new ones, if the greatest possible co-operation between maker, user and physical chemist was encouraged.

EDITORIAL NOTE.

It has been decided, on account of the rapidly increasing activity in Chemical and general Science, that for the future the number of pages in the *Chemical News* shall be raised to sixteen weekly.

The change has been rendered necessary by the large amount of matter that is being offered to the Editor for publication, consisting mostly of articles of original and progressive nature, a sure sign of the resumption of activity that was to be expected as soon as the war disruption had passed.

There is no doubt about the increase of work in the domain of Chemistry and Physics during the past few months, and everything points to better times in the near future.

THE APPLICATION OF THE PRINCIPLES OF EFFICIENCY TO THE TEACHING OF CHEMISTRY.

By J. NORMAN TAYLOR.

George Washington University.

Reprinted from School Science and Mathematics, December issue, 1921, Vol. XXI., No. 9.

By FAVOUR OF THE AUTHOR.

The principles of efficiency find immediate and valuable application in all walks of life. This short paper will be confined to an outline of them, touching upon each one as applied to chemistry teaching, but not attempting a detailed discussion.

In reading the "Study of Engineering Education" by Dr. Charles Riborg Mann¹ one is struck by his statement that "Efficiency in the mastery of materials without human intelligence to guide and control it is now recognised in all civilised countries as a curse."

Complete and true efficiency is material only in its application, and is fundamentally ethical or moral in its nature. Individuals, or groups of individuals, who do not realise and demonstrate the truth that it is servant and not master are attempting to operate against natural laws. That efficiency in the mastery of materials must be guided by common sense and morality, and that mechanical efficiency must be subordinated, offers an opportunity, says Dr. Mann, to the humanistic studies. "This has already been perceived at a number of schools, and many efforts are being made to alter the content of the courses in English, in history, and in economics to meet the obvious need."

Although efficiency cannot be defined very accurately because of its many phases and manifestations, the definition given by Harrington Emerson is comprehensive and satisfying. Personal efficiency, he states to be "mental and physical ability to find and take the best, easiest and quickest ways to the desirable things of life."

Can not we apply to the development of intelligence and to the efforts of the teacher the methods of the industrial and business world which have contributed so largely to its success?

Sir Robert Blair, in his opening address:

¹ Carnegie Foundation for the Advancement of Teaching, Bulletin 11, 1918
Nature, November 4, 1920, P. 323.

as President of Section L (Educational Science) delivered at the Cardiff meeting of the British Association for the Advancement of Science, made clear that a valuable aid to education is the implication of the teaching profession with the scientific spirit. "Matter taught and teaching methods are no longer exclusively determined by mere tradition or mere opinion." "Education as a science should be something more than mere applied psychology. It must be built up not of the speculations of theorists, or from the deductions of psychologists, but by direct, definite *ad hoc* inquiries concentrated upon the problems of the class room by teachers themselves."

No attempt will be made here to detail the subject matter of chemistry courses or its method of presentation. It will be sufficient to outline the principles which have been set forth by Mr. Emerson,¹ and under each of these to mention its application to the teaching of chemistry, together with some practical suggestions as to its application.

The principles, which may be set down as thirteen in number according to Mr. Emerson's latest classification, are divided into seven practical and six ethical ones. It will be seen that they are independent and at the same time interdependent:

The Seven Practical Principles:

1. Records.
2. Plans
3. Schedules.
4. Despatching.
5. Standardised Conditions.
6. Standardised Operations.
7. Written Standard Practice Instructions.

The Six Ethical Principles:

1. Ideals.
2. Common Sense.
3. Competent Counsel.
4. Discipline.
5. Fair Deal.
6. Efficiency Reward.

In the application of any one, or all, of these principles, it will be necessary at the outset to establish standards. In order to carry on any part of the teaching of chemistry and in fact all parts, we make use of standards, and about the first thing that is necessary to be done is to set a

standard for ourselves and for the pupils regarding how to study. For the individual teacher this may be accomplished much more easily than for the pupils. It is only after a large number of trials that standards can be established which will apply to a large group of individuals.

RECORDS.

In order to establish standards which will be just, "recourse must be made to records and they must be immediate, reliable, adequate and permanent." Convenient types of record cards are those put out by the Rand Company and by the Library Bureau. Paste board transfer cases may be used in place of the more expensive cabinets. Cheap paper stock may be cut up and used in place of heavy card stock.

Records are indispensable in determining amounts of chemicals and apparatus on hand in the laboratory as well as in the selection of the best place from which to order. Records measure progress and show its direction, and as examples we have the student's note book and the instructor's record of quizzes. The quiz record, however, may not be only of value in determining grades, but it may also "warn of wrong methods, unwise procedure, and inefficient operations." It also grades the teacher's efficiency. Records are of great value as a basis for future work.

PLANS.

Records, therefore, are useful in making plans—one of the most important of the thirteen principles. Through their consultation the instructor is enabled to plan the scope and order of the work for the year, to find out how best to allot his supply of time for laboratory and lecture work, and to plan what detail to assign to his assistants.

In planning for the best method of presentation of the subject, he may find, upon consulting his records of quizzes and of recitations, and upon comparing them with the grades evidenced from examination of the laboratory note books, that the best method is through the laboratory. Or, he may find that for a particular class the lecture table demonstration method or the project method is the most efficient. Or, that the lecture-demonstration-conversation method excels all of these. If he keeps a record of the ratings in "chemistry exercises" or study questions worked out by

Instruction by the informal recitation method has been successfully applied by

¹Emerson, Harrington. "The Twelve Principles of Efficiency." 5th Ed., Engineering Magazine Co., New York, 1917.

Professor Karsner⁴ to medical education. The method will undoubtedly prove applicable as a means of teaching some parts of chemistry.

Through consulting records the instructor can plan for equipment. Knowing through his records the amount of time supply available, he can plan for time in which to study and to keep abreast of the developments in the science. He can plan for recreation to maintain his health and permit of the greatest force and usefulness.

Karsner, Howard T., "Progressive Education" in the Teaching of Pathology," Science, July 29, 1921, pp. 81-84.

BOOKS RECEIVED.

Alchemy: Ancient and Modern, H. Stanley Redgrove, B.Sc. (Lond.), F.C.S. Pages: xx. + 141. Messrs. William Rider & Son, Ltd., 8, Paternoster Row, E.C.4. Second Edition, 1922. Price: 7/6 net.

An Introduction to the Analytical Chemistry of the Rarer Elements, by Louis J. Curtman. Pages: iv. + 64. 1922.

THE CHEMICAL SOCIETY—ANNUAL GENERAL MEETING.

The Annual General Meeting will be held at Burlington House, Piccadilly, W.1, on Thursday, March 30th, 1922, at 4.30 p.m., when the President, Sir James Walker, D.Sc., F.R.S., will deliver his Address.

An Informal Meeting will be held the same evening at 8 p.m.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 5050—Boehringer Sohn, C. H.—Process for preparation of papaverine nitrite. Feb. 21.
 566—Chapman, D. L.—Method of chlorinating hydrocarbons and their derivatives. Feb. 25.
 5340—Chemical Engineering Co.—Recovery of valuable products from pips of locust beans, etc. Feb. 23.
 981—Farbenfabriken vorm. F.—Process for manufacture of hyposulphites. Feb. 20.

- 5214—Hirschberg, L. M.—Production of formaldehyde by catalysis. Feb. 22.
 5118—Rambush, N. E.—Manufacture of producer gas with recovery of by-products. Feb. 21.
 58863—Nitrogen Corporation.—Method of producing sodium bicarbonate and hydrogen.
 175006—Wolcott, E. R.—Process for producing aluminium chloride.
 175019—British Dyestuffs Corporation. Manufacture of ortho-sulphonic acids of aromatic amines.
 175077—British Cellulose and Chemical Manufacturing Co., Ltd.—Manufacture of dialkylsulphates.
 155781—Spitz, W.—Process for the manufacture of preparations of calcium iodide fit for therapeutic purposes.
 157226—Farbwerke vorm. Meister, Lucius & Bruning.—Manufacture of a complex aurothiosalicylic acid.

Depilating Hides.—Patent No. 173,788.—A new chemical process of unhairing hides has been invented by T. B. Carmichael, of 12, Birchdale Rd., Waterloo, Liverpool, and Ockleston, W. H., of Eddisbury Lodge, Kelsall, Chester.

The hides and skins are treated with sodium sulphide and caustic soda, and consists in the use of these substances in successive and very weak solutions of a strength of approximately one-half per cent. Dry hides are preferably first softened in a 0.3 per cent. sodium sulphide solution, being then treated in a 0.5 per cent. solution, followed by treatment in a 0.5 per cent. solution of caustic soda. In an example, three pits or drums are employed, containing respectively 30, 56, and 52 lb. of material to 1,000 gallons of water, the liquors being replenished for each batch of hides and fresh liquor prepared at intervals, the depleted second sulphide bath being used for the preliminary soaking when the first bath is renewed for use as the second bath.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on, post free, for the official price of 1s. each.

NOTICES.

EDITORIAL.—All Literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the EDITOR.

SUBSCRIPTIONS £1 12s. per annum, payable in advance, should be addressed to the MANAGER. BACK NUMBERS and VOLUMES can be purchased on application to the MANAGER.

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METROPOLITAN BOROUGH OF POPLAR.

APPOINTMENT OF PUBLIC ANALYST.

THE COUNCIL of the Metropolitan Borough of POPLAR invite Applications for the Appointment of PUBLIC ANALYST.

Candidates, who must provide and maintain at their own expense an efficiently equipped laboratory within the Borough of Poplar or conveniently situated thereto, must be Fellows of the Institute of Chemistry, and possess the other qualifications and experience necessary to satisfy the requirements of the Ministry of Health.

The remuneration will be at the rate of Twelve Shillings and Six Pence per sample for a minimum of 656 Samples per annum (4 per 1,000 of population), submitted under the Sale of Food and Drugs Act, and a maximum of 800 Samples—formal and informal.

Applications, endorsed "Analyst," stating age, qualifications, experience of analysis of food and drugs, and particulars of appointments held, accompanied by copies of three recent testimonials, to be delivered to the undersigned not later than Thursday, April 6th, 1922.

Canvassing members or officers of the Council is prohibited.

The person appointed will commence his duties on the 1st July, 1922, and he shall not be entitled to or claim any superannuation allowance on retirement.

J. BUTEUX SKEGGS.

Town Clerk.

Council Offices, High Street, Poplar,

E.14

10th March, 1922.

MANAGER required for Dyeworks, to take entire control, must have practical knowledge of Silk, Cotton & Artificial Silk Dyeing.—Apply, stating age, terms and experience, to Wardle & Davenport, Ltd., Leek, Staffs.



THE MINISTRY OF AGRICULTURE AND FISHERIES has for disposal, and invites tenders for the purchase of, the contents of an analytical and chemical laboratory, including reagents used in connection with research work at the Rats Research Laboratory, Mount Pleasant, London, E.C.1. There is also a quantity of factory apparatus used for the manufacture of rat bait.

A list of the articles for disposal will be supplied upon application to the Disposal Officer, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

Application for permission to inspect the apparatus should be made direct to the Research Chemist at the Laboratory. (Telephone: City 181).



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THE following will be included in the Sale:—7 Section Boiling Column, Copper Rectifying Column, 8 Brass and Copper Condensers, Hydrogen Plant, Silicol Plant, Caustic Mixing Plant, 6 Sets Heavy C.I. Retorts for Nitric Acid.

Catalogues and all particulars of the Auctioneers, Messrs.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3233.

SCIENCE HONOURS MADAME CURIE

AT THE AMERICAN MUSEUM.*

The New York Academy of Sciences, the American Museum of Natural History, and the New York Mineralogical Club, recently united to do honour to Madame Marie Curie, "a lady whose name," to use the words of Dr. George F. Kunz, who presided on the occasion, "will live long, long after those who have aspired to fame ostentatiously or otherwise, will all have passed away."

Two testimonials were presented to the discoverer of radium—the one a certificate signalling her election as an Honorary Fellow of the American Museum of Natural History, the other conferring upon her Honorary Membership in the New York Mineralogical Club. In bestowing the former, President Osborn said:—

"My pleasant duty to-night is to extend the hospitality of the American Museum of Natural History to Madame Curie, and to announce that, by unanimous vote of the scientific staff, and unanimous vote of the trustees of this institution, we have elected Madame Curie an Honorary Fellow of the American Museum of Natural History. I have in my hand the certificate of membership, and I would present this certificate to Madame Curie with the statement that she is the first woman to receive this honour; that it is given in recognition of her great discovery in the fields of physics, of mineralogy, and of chemistry; and that we give it with the greatest enthusiasm because of the fundamental character of her discoveries in these fields.

"Madame Curie, may I greet you as an Honorary Fellow of the American Museum of Natural History?"

In presenting the certificate of honorary membership in the New York Mineralogical Club, a ceremony which took place toward the close of the evening, Professor Phillips spoke as follows:—

"The New York Mineralogical Club, by unanimous vote, at the annual meeting of the organisation, on the evening of April

* Abridged account of the proceedings at the American Museum, by favour of Dr.

George F. Kunz.

20, 1921, at the American Museum of Natural History, desiring to express its fullest appreciation of Madame Curie and her transcendent service to humanity through the discovery of radium in the year 1898, and many great contributions to radial knowledge since, hereby confers Honorary Membership, with life tenure appended thereto.

"It gives me great pleasure to present this, Madame Curie, and the three organisations that arranged this meeting are here to honour you, Madame Curie, and to show their appreciation of your great services to humanity."

Madame Curie, in reply, said:—

"I am very grateful to the New York Academy of Sciences, the New York Mineralogical Club, and the American Museum of Natural History, for this beautiful reception and for the recognition of my work.

"I cannot say how happy I am that I was permitted to be the discoverer of radium, but I would like to remind you of the names which are associated with this, of which you know many—as Sir William Ramsay, Berthelot, Rutherford, Soddy, Becquerel, Abbe, etc.

"Then I would like to say how deeply I am moved by the beautiful progress of the medical application of radium, of which you have just now heard from Doctor Abbe, and we must remember that the success of that is due, not only to the discovery itself, but also to the splendid efforts of distinguished specialists which were made and especially by Doctor Abbe, and we must be thankful to all of them, just the same as to the discoverer."

The Calcutta Pottery Works affords an outstanding instance of modern Indian enterprise in the establishment and development of an important industry. In an article contributed to the February number of the *Journal of Indian Industries and Labour*, Mr. S. S. Deb gives an interesting account of these works, illustrated by three excellent photographs, with a brief resumé of the methods and progress of the art of ceramics in India up to the present day. India has not to look outside her own territories for the raw material necessary to this industry, which has a great future before it provided that it is conducted along the right lines. The Calcutta Pottery Works sets an example worthy of emulation.

REACTIONS BETWEEN THE HIGHER FATTY ACIDS AND SALTS OF THE LOWER FATTY ACIDS.

(BY ARTHUR W. KNAFF AND RAYMOND V. WADSWORTH.)

This investigation resulted from our discovery of the following fact:—

If finely powdered sodium acetate is added to oils, or melted fats, a jelly or gelatinous precipitate is generally produced.

The anhydrous salt gives more, and the anhydrous salt most jelly. Sodium propionate and sodium butyrate produce similar results. Jellies occupying from one-third to eight-ninths of the volume of the oil were obtained by warming 5 per cent. of the anhydrous sodium acetate with oils consisting mainly of different characteristic glycerides, such as linseed oil, coconut "stearine, cacao-butter and olive oil (the oils contained from 0.5 to 2.5 per cent. of oleic acid 1.2 per cent.) gave no jelly. This characteristic action of castor oil has not been further investigated. It would appear either that ricinoleic acid does not decompose the acetate, or if it does, that the soap formed remains in solution.

If the oils are washed with alcohol so as to free them from fatty acids, no jelly is obtained with acetate. That the acetate does not react with the glycerides is also shown by the fact that no acetin is formed. Free glycerides do not react with sodium acetate, but samples of the following glycerides, which had been prepared six years and hence were slightly decomposed, gave gelatinous precipitates:—

tributyrin	trilaurin	trimyristin
tripalmitin	tristearin	triolein

The jellies so obtained are soaps, formed by the interaction of sodium acetate and the free fatty acids. We have here the basis for a new method of removing fatty acids from fats which might prove to have important technical applications.

Action of Salts with Fatty Acids.—It is well known with regard to the fatty acids that the greater the molecular weight the weaker the acid. This is stated to be well shown, for example, by the marked de-

crease in the heat of neutralisation. But we find that if the higher fatty acids be put in presence of the salts of the lower fatty acids, the weaker drives out the stronger. The first cause of this reaction is that the salts are soluble in the acids: whereas the soaps form only colloidal solutions. On applying heat, the reaction proceeds because the stronger acids are the more volatile, and hence in this respect the action is analogous to the action of sulphuric acid on sodium chloride. Thus if sodium acetate is added to liquid stearic acid, the odour of acetic acid is perceived, and if the mixture is heated to 110° C. for some hours so that the acetic acid can escape, the action continues to completion, and pure sodium stearate remains. A similar reaction takes place with palmitic, myristic, lauric, and even caproic acid. From the fatty acid and salt a clear solution can be obtained which appears to be a colloidal solution of the soap. This is best observed with oleic acid, which acts in the same way as the saturated acids. Sodium acetate is soluble in oleic acid at 30° C., and is crystallised out from solution at about 22° C. At 40° C. about 10 per cent. can be dissolved. As soon as the sodium acetate is dissolved the oleic acid becomes more viscous. At 100° C. molecular proportions of oleic acid and sodium acetate give a clear solution. On cooling, this becomes a very thick jelly. Contrary to expectation we find that when either stearic or oleic acid is mixed with an equivalent proportion of sodium acetate, heat is given out.

If the fatty acid, e.g., stearic acid, is dissolved in absolute alcohol and the acetate added, a gelatinous precipitate of soap is formed almost immediately. If water is now added, the reaction is reversed and we obtain the original fatty acid and sodium acetate.

Colloidal Soaps in Oils.—If one per cent. of sodium acetate, propionate, butyrate, caproate, myristate, laurate, palmitate, stearate or oleate be added to an ordinary fat or oil (containing as usual free fatty acids) and warmed, a jelly or gelatinous precipitate (which in time settles towards the bottom of the vessel, forming a denser and more visible mass) will be formed in the case of the salts of the lower fatty acids. This is due to the reaction we have described above. With the salts of the higher fatty acids a certain amount of the salt or

soap goes into solution, but precipitates on cooling as a gelatinous mass. This is only clearly shown when a large percentage of fatty acids or olein, in which the soaps are soluble, is present. Sodium formate differs from the other salts, in that it is a salt of a much stronger acid, and its solubility in fatty acids is very low; consequently it does not give a jelly with olive oil, and only very slowly reacts with the higher fatty acids to form soaps.

All the jellies are formed most readily in the complete absence of water. They can be obtained as solutions in olive oil (which is rich in olein) by warming and filtering at 100° C. The soaps, under these conditions, are reversible colloids. On cooling, the jelly is usually slowly deposited as a mass of minute globules.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, MARCH 16, 1922.—

Sir Charles Sherrington, President, in the Chair.—The following papers were read, the Summaries here printed having been supplied by the Authors for use at the Meeting:—

H. H. DALE, M.D., F.R.S., and C. H. KELLAWAY. Anaphylaxis and Anaphylatoxins.

The paper deals with the two main theories put forward to explain anaphylaxis to a soluble foreign protein: (1) the theory of cellular antibody, and (2) that of anaphylatoxin. New evidence is produced in favour of (1).

A purified, concentrated precipitin for crystallised egg-albumin was prepared, and a control preparation was made of similarly concentrated globulin from normal rabbit's serum. Guinea-pigs were rendered passively anaphylactic to egg-albumin by an injection, two days previously, of the precipitin. Intravenous injection of a further dose of the same precipitin, given a few minutes before a dose of egg-albumin, suppressed the anaphylactic reaction completely; normal rabbit globulin showed no trace of such protective action.

Similarly, isolated plain muscle from anaphylactic guinea-pigs suspended in saline solution, was completely protected from the stimulating effect of egg-albumin by adding to the bath the precipitin which caused the

anaphylactic condition: normal globulin had no protective action.

The nature of so-called "anaphylatoxins," produced by digesting serum with carbohydrate sols, etc., has been examined. Evidence is produced that their toxicity is due, not to protein cleavage, but to formation of complexes which keep the foreign colloid finely dispersed in the finished product.

The anaphylatoxins produce symptoms which are not identical with those of true anaphylactic shock, and they do not act on isolated plain muscle, as the anaphylactic antigen does, but only exhibit their action in the presence of the circulating blood. Their action is attributed to exposure of the blood to a large foreign surface. One dose of anaphylatoxin renders an animal insensitive to another, but leaves it, if anaphylactic, sensitive to the antigen.

Conclusions are drawn in favour of (1) and adverse to (2).

J. G. BRAMWELL and PROF. A. V. HILL, F.R.S. The Velocity of the Pulse Wave in Man.

The velocity of the pulse wave, relative to the blood in the vessel, is given in metres per second, by

$$v = 3.57 \sqrt{\text{percentage increase in volume of vessel per mm. of Hg. increase of pressure.}}$$

An observation of the velocity, therefore, gives the degree of extensibility of the vessel, and is one criterion of an efficient circulation.

The experiments of Roy (1880) on the extensibility of blood-vessels may be used to calculate the velocity of the pulse wave; the calculation shows: (a) that pressure has a considerable effect on the velocity, a fact which is confirmed by experiments on an isolated human artery, filled with mercury to slow the transmission of the wave; and (b) that the velocity so calculated is less than that observed in man, a fact which is attributed to the "elastic after-action" which affected Roy's measurements. Experiments on an isolated human artery gave a velocity comparable with that observed in man.

It is concluded that the transmission of the pulse wave is a purely mechanical effect, its velocity depending on the extensibility of the vessels as modified by any condition (muscular or otherwise) pertaining at the moment.

ALEXANDER FLEMING, M.D. On a New Bacteriolytic Element found in Tissues and Secretions. Communicated by Sir Archibuth Wright, F.R.S.

A substance has been found in tissues and secretions which is strongly bacteriostatic, bactericidal, and bacteriolytic. This substance has been called a "microzyme."

A coccus (*Micrococcus lyticus*) appeared in cultures made from the nasal mucus of a patient suffering from acute oxyza. This coccus has been found to be particularly susceptible to the action of a microzyme, and has been used as an indicator in experiments on its properties and distribution.

Microzyme is precipitated from albuminous solutions by protein precipitants; it is very susceptible to small changes in the reaction of the fluid, being inhibited by 1/800 normal acid or alkali; it will not pass through a palladium membrane; filters of porcelain, cotton wool or filter paper absorb microzyme from first portion of fluid filtered, but when saturated the microzyme passes freely through the filter.

Microzyme affecting *M. lyticus* was found to be present in varying amounts in practically all tissues of the human body. Especially strong were epidermal structures, respiratory mucous membrane and fibrous, fatty and cartilaginous connective tissues. Among body fluids, tears, sputum and nasal mucus are very rich in microzyme, saliva and blood fluids less so, while normal urine, sweat and cerebro-spinal fluid apparently contained no microzyme for *M. lyticus*. Tissues of dog, rabbit and guinea-pig all contain microzyme for *M. lyticus*, but usually in less amount than corresponding human tissues. Egg-white was found to be particularly potent, showing lytic action even when diluted 1 in 50 millions.

A small amount of microzyme for *M. lyticus* was found in the turnip. In human secretions microzyme was found exercising lytic action on most bacteria of the laboratory air, on bacteria pathogenic for animals but not pathogenic for man, and on many cocci isolated from the human body.

It is suggested that microzyme plays a large part in natural immunity and in immunity of particular tissues to particular infections.

J. W. PICKERING, D.Sc. and J. A. HEWITT, Ph.D. The Action of "Peptone" on Blood and Immunity thereto. Communi-

cated by Prof. W. D. Halliburton, F.R.S.

The retardation of the coagulation of the blood resulting from the rapid intravascular injection of "peptone" into cats respiring air, or into cats with the liver out of the circulation, can be annulled by an increase of carbon dioxide in the blood. The anti-coagulant action of "peptone" is restored when the animals respire an excess of air or oxygen.

In cats respiring air, typical "peptone" retardation of coagulation can be produced by its rapid injection into animals with the liver out of the circulation. An explanation is given of the negative results of certain French experiments. Typical inhibition of the coagulation of the blood can be obtained by the addition of "peptone" to blood *in vitro*, with quantities of "peptone" no greater than those required to produce inhibition *in vivo*, provided the disturbance of the surface conditions of the blood, incidental to shedding, is sufficiently reduced. Leucocytes play no part in the anti-coagulant action of "peptone" on blood.

It is superfluous to assume that the anti-coagulant action of "peptone" on blood is due to the secretion of either antithrombin by the liver or by the endothelial cells of the vascular system, or is due to the secretion of excess of alkali by the liver. The slow injection of maximal amounts of "peptone" into cats, with the liver out of circulation, produces typical immunity to anti-coagulant action.

The hypotheses which assign "peptone" immunity to hepatic secretion are dismissed and a physical explanation is suggested. Perfusion experiments on the liver do not demonstrate that anti-thrombin is secreted by that organ. In the interpretation of the coagulation of the blood it is unnecessary to assume, as in current views, the existence of the following hypothetical substances, anti-thrombin, preantithrombin and anti-prothrombin, and the current "thrombin theories" become untenable.

THE GEOLOGICAL SOCIETY OF LONDON.

MARCH 8TH, 1922.—Mr. R. D. Oldham, F.R.S., Vice-President, in the Chair.—Dr. A. Smith Woodward described certain photographs (natural size) of *Desmostylus* teeth from the Lower Miocene Sandstone of

Southern Vancouver Island (B.C.) exhibited by Ira E. Cornwall, F.G.S.

The following communication was read: "On the Geological Importance of the Primitive Reptilian Fauna in the Upper Cretaceous of Hungary." By Baron Francis Nopcsa, For. Corresp. G.S.

The next meeting of the Society will be held on Wednesday, March 22nd, 1922, at 5.30 p.m., when a lecture will be delivered on "Leonardo da Vinci as a Geologist," by Sir Charles J. Holmes, F.S.A., Director of the National Gallery.

SOCIETY OF GLASS TECHNOLOGY.

A meeting of the Society of Glass Technology was held in Stourbridge on March 15th.

During the forenoon, members had an opportunity, through the courtesy of the respective directors, of visiting the works of Messrs. King Bros. (Stourbridge), Ltd., and of Messrs. E. J. & J. Pearson, Ltd., both firms being engaged in the manufacture of refractory materials.

The following papers were read and discussed:—

"Some notes on the production of Colourless Glass in Tank Furnaces," by A. Cowen, B.Sc., A.R.C.S., and Prof. W. E. S. Turner, D.Sc.

"Review of the Preliminary Specification for Refractory Materials used in the Glass Industry," by W. J. Rees, B.Sc. Tech., F.I.C.

The General Meeting of the Society will be held at Sheffield on April 6th.

THE OPTICAL SOCIETY.

At a meeting of the Optical Society, held at the Imperial College of Science and Technology, on Thursday, 9th March, Sir Frank Dyson, President, in the chair, the following papers were presented and discussed:—

1. "A criticism of the nodal slide as an aid in testing photographic lenses," by T. Smith, M.A., F.Inst.P., and J. S. Anderson, M.A., D.Sc., Ph.D., F.Inst. P.

The nodal slide is only convenient for the examination of lenses over their entire field when these are of normal type.

Collimators and lenses should in general be directed to pass through all useful light as symmetrically about their axes as possible. Failure to secure this condition may lead to an underestimate of the excellence of good lenses, as well as an underestimate

of the gravity of the faults present in bad lenses.

The nodal slide may with advantage be supplemented by suitable linkages, which enable all the special conveniences of the nodal slide to be retained. Some of the possible modifications are discussed.

2. "A non-polarising spectrophotometer," by A. J. Bull, M.Sc., F.Inst.P.

The paper deals with a form of spectrophotometer in which uniform monochromatic patches of colour are compared, instead of the more usual arrangement of two portions of a spectrum. A spectrum is arranged so that the upper half has undergone selective absorption by the material under test, and a narrow region of the spectrum is selected by a slit. A split lens then forms two images of the dispersing prism face. These images are brought into juxtaposition by means of a rhomb-like prism with slightly unequal angles, which corrects the divergence of the two beams produced by the split lens. Photometric balance is required by the partial closure of the lower portion of the selecting slit.

3. "The photometry of optical instruments," by J. Guild, A.R.C.Sc., F.R.A.S., F.Inst.P.

The use of a portable surface-brightness photometer of the polarisation type for the measurement of the fraction of the incident light transmitted by an optical instrument or reflected by a mirror or system of mirrors, and for the measurement of the relative brightness of different parts of the field of view of an optical instrument, is described. The instrument employed is a Wanner optical pyrometer (Cambridge and Paul Inst. Co.) with some modifications to render it suitable for such work. An addition to the instrument is described which removes the danger of error due to polarisation of the incident light.

4. "A projective treatment of the submarine periscope," by T. Smith, M.A., F.Inst.P.

The optical events which occur in an instrument such as a periscope may be illustrated by homocentric projection, and it is shown that this affords a simple means of finding the relative advantages or disadvantages of various arrangements of the optical system.

5. "Some measurements of the stresses produced at the surfaces of glass by grinding with loose abrasives," by A. J. Dalladay, A.Inst.P.

The method of measuring the stresses at the surface of a piece of "greyed" glass is

described, and measurements are given showing the relation between the size of grains of the abrasive used and the stresses produced.

THE SOCIETY OF DYERS AND COLOURISTS.

MANCHESTER SECTION.

A meeting of the Manchester Section of Dyers and Colourists was held on Friday, March 17th. Prof. E. Knecht presided.

Two papers were read and discussed, the first being entitled, "Some Observations on the Behaviour of Oxidised Cellulose," by Prof. E. Knecht, Ph.D., M.Sc.Tech., F.I.C., and F. P. Thompson, M.Sc.Tech., on the second, "A New Protective Agent for Animal Fibres," by Alfred Edge. There was a very large attendance of members.

"SOME OBSERVATIONS ON THE BEHAVIOUR OF OXIDISED CELLULOSE."

Prof. Knecht, who read the above titled paper, said that it related to the effect of oxidation on the copper reducing property and ester reaction of cellulose. A method of determining the extent to which cellulose had been modified by oxidation or hydrolysis was described by Schwalbe in 1907. The cellulose product was boiled under standard conditions with alkaline solution of copper sulphate, and the amount of copper reduced had been termed the copper number of the product. Pure cellulose was without reducing action but, oxidised with hydrolysed cellulose, together with certain esters, produced certain quantities of copper. In the more recent accounts of investigation of cellulose the copper numbers of the products were recorded. The actual numbers were of little importance, the chief significance being the higher the copper number the further was the product removed from pure cellulose.

The copper numbers of oxidised cellulose prepared by the various oxidising agents or processes varied considerably. This was no doubt due to the different conditions and variations in the extent to which oxidation had taken place. By the use of potassium permanganate in dilute acid solution, for the oxidation of cellulose, as described by the Secretary and himself in 1920, products could be obtained, the degrees of oxidation of which were known by the amount of oxidising agent employed. This process had now been used to prepare a series of

products not varying the known degree of oxidation, and the copper values were ascertained in each case for the purpose of discovering whether any simple relation existed between them and the amount of oxidant used in their preparation. Well bleached cotton yarn was used as the most convenient form of cellulose throughout the investigation, and the oxidation products were prepared by the use of permanganate to apply from one-sixteenth to 1, atomic proportion of oxygen per cellulose molecule counted on the $C_6H_{10}O_5$ unit. Weighed amounts of yarn were suspended in cold sulphuric acid of 10° twaddel, and to this was added the calculated amount of permanganate as concentrated solution, also in 10° twaddel Sulphuric Acid, so that no dilution ensued. The yarn was turned periodically in order to obtain an even result. The series was allowed to stand until oxidation was complete in every case, which required about 10 hours. A blank experiment was carried out without the addition of oxidising agent. There was always a small deposit of manganese dioxide on the fibre during permanganate oxidations. In the previous investigation this deposit had been estimated to amount to not more than five per cent. of the total amount of permanganate employed, so that it was almost a negligible quantity. The products were finally decolourised with hydrogen peroxide and well washed and dried at a temperature not exceeding 30° C.

A number of tables were exhibited showing the results of the experiments in detail and giving exact data as to proportions.

In concluding the reading of the paper, Prof. Knecht said that in the initial stages of oxidation of cellulose by permanganate in cold acid solution, the rise in copper number was nearly proportional to the amount of oxidant used up. After the use of half the atomic proportion the rise in copper number was very gradual. The acetylation of oxidised cellulose was not found to give any indication of the effect of oxidation on the hydroxyl groups of cellulose, which was due to the very great reduction in the yield. Highly oxidised cellulose gave a high yield of water soluble products on acetylation. When nitrated under identical conditions oxidised cellulose gave products containing considerably less nitrogen than cellulose. It was inferred that oxidation resulted in the suppression of the

hydroxyl activity. Under the conditions which cellulose gave, labile mono-nitrate oxidised cellulose produced considerable quantities of nitric acid.

AN INTERESTING ISOLATION.

Before proceeding to the discussion of the paper, Prof. Knecht announced that, in collaboration with Mr. C. A. Hatton, B.Sc., Tech., he had recently succeeded in isolating the nitrogenous cell content of the bleached cotton fibre. That something of the kind was present they had already known from experiments which were carried out by Dr. Schindler, in his (Prof. Knecht's) laboratory about 12 years ago. From the results of the nitrogen estimations it was concluded that the amount of albuminoid contained in the cotton fibre would be about 1.3 per cent. They had now isolated the albuminoid and it amounted to 1.2 per cent. It was an interesting substance, and further research work was being undertaken, the results of which it was hoped to report at a subsequent meeting.

Mr. J. Hannay, in proposing a vote of thanks to the authors for their paper, said that the chief difficulty of those who were interested in cellulose and its varied uses was to keep abreast with the steady advance of the research work which was being made. He hoped that before long some work would be published in which would be published all the information which had been so laboriously gleaned. It was very interesting to be reminded that Prof. Knecht had called attention to the Ketonic action of cellulose, years previously, in view of the fact that a short note had been read at a recent meeting of the Manchester Section of the Society of Chemical Industry by Mr. Huebner, who had ascertained that ketones were discoverable in water over which a portion of bleached cotton had merely been suspended for a certain number of hours. What the actual bearing of this discovery might prove to be upon works practice it was too soon to say. Such research work, however, was bound to enlighten them all as to the manner in which OH groups were attached to the carbon-cellulose atom, and was bound ultimately to have the greatest importance in regard to the practical application of cotton to cellulose in different forms of industry.

Mr. William Thomson, in seconding the vote of thanks, observed that the peculiarity that oxidised fibre gave a different amount of nitration from that obtained from the actual cotton without being oxidised,

was exceedingly interesting. The sample contained in the small bottle exhibited contained what was practically albumen. Perhaps it was possible to extract from cotton a product which was equivalent to egg? The product shown did not appear very appetising, but possibly if it was bleached it might be compounded into an exceedingly interesting food.

Mr. William Marshall, in supporting the vote of thanks, said that everyone seemed to fight shy of the constitutional formula of cellulose. Some years ago he had done some work on the acetylation of cellulose with the idea of keeping the fibre intact and not producing a solution. He found that mercerised cotton, for some considerable time, would not acetylate at all. There seemed to be a prevalent idea that the constitution was not very much altered from the chemical point of view. He, however, believed it was. The acetylation would start all right with the ordinary pure bleached cellulose. He had about 20 experiments going on at once, the periods extending from one hour to 20, and eventually the mercerised cellulose would overtake the other, so far as the acetylation was concerned, but it also became so tender it could be powdered. It was a matter for inquiry as to whether mercerisation altered the molecule. He followed up the matter time after time, and always obtained the same result. The field of investigation thus opened up was a very wide one.

Prof. Knecht, in replying to the vote of thanks, said he was pleased to find it was considered that Mr. Thompson and himself had been able to make a little step forward in the study of oxidised cellulose. Apparently they would have to get the structure of cellulose built up by very little stages. He was very interested in Mr. Marshall's statement respecting the tendering of mercerised cotton, though he was unable to offer any explanation for the phenomenon. He was also not going to attempt to give a constitutional formula of cellulose.

"A NEW PROTECTIVE AGENT FOR ANIMAL FIBRES."

Mr. Alfred Edge, in reading his paper, said that the action of alkali upon wool, unless special care was paid to the strength of the alkaline liquors and the temperature at which the material was treated, was known to be very deleterious. If the treatment was too severe, the fibre might be completely destroyed. Between the wool fibre in its original condition, with

its natural strength and lustre unimpaired, and the point of actual destruction there was a wide range of effect in which the durable qualities of the wool were more or less impaired, and its wearing qualities deteriorated. Having regard to the fact that a cleansing process with alkaline liquors was an essential feature in the production of textiles from wool fibre, it was somewhat surprising that the information available was so little applied in actual practice. Another point to be considered was the serious effect of the liquors upon the skin of the workman. At some mills both fine and coarse quality wools were given exactly the same scouring treatment, at others soap was used in hard water, and very seldom had the scourer any idea of the condition of the scouring bath. That important injury to the fibre was often caused in scouring was beyond question, and yet it was difficult to convince those responsible for the scouring operation that the process was worthy of careful and scientific investigation. So long as the wool was clean the object of the process was considered to be achieved. As to the effect of a too severe treatment during washing on the affinity of the fibre for dyes, no definite information was, to his knowledge, available, but it was at least possible that some of the dyers' troubles were due to a too drastic scouring while they knew that others were caused by an ineffective cleansing of the material. The Actien Gesellschaft fur Anilin-Fabrikation (Berlin) were now placing upon the market a product which they termed "Protectol." It was at present sold in the form of syrups which were readily soluble in water. The composition of the product could not be disclosed at present. The quantity to be used varied according to the quantity of alkali present. As a rule, half as much "Protectol" as soda ash was sufficient to afford protection from injury to the wool.

Mr. Edge then exhibited samples of wool which had been treated with "Protectol," and described its application to dark coloured rags, union dyeing, woollen piece goods, etc.

The one-bath method of union dyeing had been largely used during the past 25 years for all classes of materials, but particularly for the lower qualities. The method had disadvantages well known to dyers, and which were due to the operation being carried out in a neutral or slightly alkaline

bath. This made it unsuitable for the more expensive and delicate union fabrics such as "pile" goods. The use of "Protectol" overcame these difficulties, and were a safeguard to the action of alkali.

"Protectol" also prevented the precipitation of the dye stuff by acids.

It was also now possible to rapidly and safely de-gum silk in an alkaline bath without damage to the fibre and with a great saving of steam and labour. The method had been successfully adopted by some of the most important silk firms in the country.

The dyeing of cotton with sulphide colours in mixed fabrics consisting of cotton and wool was also rendered possible.

A peculiar effect was noticed in the treatment of cotton and silk fabrics. A preliminary treatment with caustic soda was given in some cases, in order to increase the affinity of the cotton for dyes. This was usually carried out at a low temperature with caustic soda of 43° twaddel. When "Protectol" was used there was no shrinkage of the cotton during partial mercerisation, but the increase of affinity for the dyes, which was the reason for the process, was obtained just the same, and the silk was degummed without injury to the fibre.

In the dyeing of half silk with sulphide dyes various effects could be obtained with a proper regulation of the temperature.

Very unsatisfactory results had been obtained in the treatment of furs which were put through a process known as "liming." The object was to make the tips of the hair more receptive to the dye, and also to remove grease and tannin. The operation had a very detrimental effect on the fur itself, making it brittle at the tips, particularly so in the case of the more valuable furs. "Protectol" had given excellent results when used in conjunction with the "killing" liquors.

Its use had also been found quite satisfactory in the leather industry when applied to what was termed the "liming" process for loosening hair.

A large firm of dyers and cleaners in this country were also using it as a protective agent in the dyeing of feathers.

The product has only recently been introduced into this country, and already very great interest has been taken in it. It was immediately taken up by several important silk firms. It is the intention of the manufacturers to place the substance

upon the market in a solid form, which by reducing the cost of carriage will make its use possible for even the cheapest classes of goods.

A large number of enquiries respecting further possible uses of the substance in connection with the dyeing and textile trades were then addressed to, and answered by Mr. Edge.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

The next meeting of the Society will be held on Wednesday, April 5th, at the Chemical Society's Rooms, Burlington House, Piccadilly, W., at 8 p.m.

The following papers will be read:—

"The Constants of Indian Beeswax," by O. D. Roberts, F.I.C., and H. T. Islip, A.I.C.

"Note on the Liver Oil of the 'Tope' (Galeus galeus)," by A. Chaston Chapman, F.R.S., F.I.C.

"Note on the Examination of Foods for the presence of Sulphites," by A. Chaston Chapman, F.R.S., F.I.C.

"Demonstration of Artificial Daylight for Laboratory Purposes. (Sheringham System)," by Sydney H. Groom, B.A.

"A Tropical Milk Supply," by Alexander Bruce, B.Sc.

"Certain Tropical Oilseeds," by E. R. Bolton, F.I.C., and D. G. Hewer, B.Sc.

STUDENTSHIPS.

CITY OF LONDON COLLEGE, WHITE STREET, MOORFIELDS, E.C.—DAY SCHOOL OF COMMERCE.

A limited number of free places will be awarded on the results of an examination to students resident in the administrative County of London who, in the opinion of the Governing Body, cannot be expected to pay the ordinary fee.

The Studentships will be tenable for the Academic Year commencing Tuesday, 19th September, 1922. Candidates must be sixteen years of age or over on that date. The Studentships may be renewed by the Governing Body for a second year upon a satisfactory report of the student's progress from the Headmaster. Those who obtain Studentships may take a course in preparation for the Intermediate Commerce Examination of the University of London or, if girls, the Secretarial Course.

The examination will be held at the City

of London College on Thursday, 1st June, 1922, from 10 to 1, and 2 to 4.

The subjects of examination will be:—

(a) English Essay.

(b) Mathematics including Arithmetic, Algebra, and Geometry.

(c) French.

The scope of the examination in these subjects will be roughly that of the Matriculation of the University of London.

Form of Entry and further particulars can be obtained from the Secretary.

G.

R.

BY DIRECTION OF THE DISPOSAL BOARD.

CHEMICAL NOTICES FROM FOREIGN SOURCES

SOLUBILITY OF ISOMERIC ACIDS IN THE THREE XYLENES—*M. Chapas*.—Para-toluic acid is only very slightly soluble in the three xylenes. The author has already shown that p-nitraniline is also very much less soluble in m-xylene than its isomers. These facts recall the lower volatility of the para derivatives of benzene. Meta-toluic acid has the highest coefficients of solubility, but they are not very different from those of the o-toluic acid. If the solubilities of the same acid in the three solvents are compared, it is seen that p-xylene has the greatest solvent power, while that of m-xylene is the least, but isomerism does not seem to have a great effect upon the solvent power of a compound.—(*Comptes Rendus*, CLXXIV., 1922, No. 9.)

CATALYTIC PREPARATION OF CYCLOHEXANE TRIOLS—*J. B. Senderens and J. Aboulenc*.—When pyrogallol is reduced in an aqueous or alcoholic solution and under a pressure of 40–50 Kg in presence of nickel, two isomeric pyrogallites are formed. The reduction is complete at a temperature of 140°, and the product does not give the reactions of pyrogallol. The two isomers can easily be separated owing to the difference in their solubilities in both water and alcohol. Pyrogallite melts at 145°, and distils without undergoing decomposition at 290°. It is less soluble in alcohol than in water. The α_2 compound is more soluble in alcohol than in water, and melts at 95°. Both compounds combine with three molecules of acetic acid to give a triacetate. Phloroglucine can easily be reduced in aqueous solution under pressure, the re-

action occurring according to the equation $C_6H_5(OH)_2 + 3H_2 = C_6H_5(OH)_3$. The mixture of phenolguenites thus obtained is gelatinous and distils at $215-260^\circ$. It combines with three molecules of acetic acid. Exactly the same reduction can be brought about with oxyhydroquinone, a mixture of isomeric oxyhydroquinones being obtained. — (*Comptes Rendus*, CLXIV., 1922, No. 9.)

SOME DERIVATIVES OF SUBERONE—*Marcel Godehot and Pierre Bonn*.—When calcium hydride acts on suberone a very good yield of cycloheptylidene-cycloheptanone $C_7H_{12} = C_7H_{10}O$ is obtained. This new bicyclic unsaturated ketone is a liquid which boils at about $143-145^\circ$ under 8 mm. pressure. When hydrogenated by means of absolute alcohol and sodium, it gives a secondary alcohol $C_7H_{12} - C_7H_{12}OH$. The authors have incidentally studied the action of bromine upon suberone. When a little bromine dissolved in an excess of carbon tetrachloride is added to a similar solution of suberone dibromo-suberone $C_7H_{10}OBr_2$ is obtained. It is noteworthy that when bromine acts on cyclohexanone or cyclopentanone a tetra bromo derivative is obtained. Unlike these tetrabromo compounds, dibromo suberone is very stable, and can be kept for months without undergoing any alteration, even when exposed to light. When treated with dilute soda in the cold, it yields a syrupy substance, very soluble in various solvents, uncrystallisable and decomposing on distillation, even in a vacuum. It very readily reduces Fehling's solution, and is in all probability a cycloheptane diol-one. — (*Comptes Rendus* CLXIV., 1922, No. 9.)

DEWINDTITE, A NEW RADIOACTIVE MINERAL.—*Alfred Schoep*.—This mineral comes from Kasolo (Katanga, Belgian Congo). It is found mixed with chalcolite. It is canary yellow in colour, pulverulent or rarely compact, and impregnates certain pieces of chalcolite so as to fill in all the spaces which occur between the crystals of this mineral. It can be extracted without much difficulty by washing with distilled water, but it is not so easy to separate the yellow mineral from a sort of white gangue, which occurs mixed with the chalcolite and which resembles an impure tale. The yellow mineral crystallizes in spangles, the radioactivity of which is higher than that

of kasolite. The average composition of the mineral is as follows:—

P_2O_5	10.01	
UO_3	55.50	
PbO	21.74	
Fe_2O_3	2.06	(Very little Fe_2O_3)
Al_2O_3		
CaO	1.32	
MgO	2.75	
H_2O	5.82	
Insoluble matter	0.10	
	99.60	

The white gangue, when treated with hydrochloric acid and heated, partly dissolves, the insoluble residue amounting to 30.24 per cent. The solution contains 33 per cent. of Al_2O_3 , 11 per cent. of MgO , and 5 per cent. of CoO . The author suggests the name dewindtite for the new mineral, in honour of Dr. Jean Dewindt, the Belgian geologist.

NOTES ON BOOKS.

Organic Syntheses (Vol. I).—An annual publication of satisfactory methods for the preparation of organic chemicals. Editor-in-chief, ROGER ADAMS. New York: John Wiley and Sons. London: Chapman and Hall Ltd. 1921, pp. viii. plus 84. Price 8/6 net.

Since 1914, American chemists have been unable to obtain adequate supplies of many organic reagents. The necessity arose for investigators to prepare comparatively simple bodies, such as alkyl haloids, for their own use.

The present volume (the authors term it a pamphlet) is the first of a series in which the joint authors intend to make the results of their investigations permanently available, giving reliable methods for preparing such chemicals in quantities ranging from 200 grms. to 2.5 kilos. Complete directions are given for the preparation of 23 substances. The most suitable method and apparatus are specified, and the temperature limits and time required for each stage are recorded. The yields quoted are generally higher than those usually obtained for such preparations, although there is little new in the methods employed.

Only results that have been duplicated in two laboratories are included. As a result of this commendable procedure, widely different substances, such as trimethylene bromide, benzoin, furfural, thiophenol, etc., are among the twenty-three compounds whose preparation are described. The processes are generally very satisfactory ones, but the method given for the preparation of a 48 per cent. solution of hydrobromic acid is the interaction of bromine and sulphur dioxide in the presence of water. The authors are apparently unacquainted with Pickle's method (*Chemical News*, 1919, 119, 89) in which sulphuric acid acts upon potassium bromide in the presence of a little stannous chloride.

Notes on other modes of preparation for each substance are appended, and the reasons are given which led to the selection of the method finally chosen.

Aggregation and Flow of Solids, by SIR GEORGE BEILBY, F.R.S. London: Macmillan & Co., Ltd., 1921; pp. xvi. plus 256 plus 34 plates. Price 20/-.

In this volume the author has compiled the results of his studies, extending over 20 years, on the Micro-structure and physical properties of solids in various states or aggregation. A theory of polishing of metal and other surfaces is advanced, in which it is considered that the phenomena associated with polished surfaces are due to the presence of a surface tension skin as in the case of liquids. This is the conclusion reached as the result of exhaustive studies of polished surfaces, especially in the case of speculum metal, and a repetition and extension of Faraday's experiments on the thinning of gold leaf by treatment with potassium cyanide solutions.

Micro-photographs—some of high magnification taken in natural colours with autochrome plates—clearly demonstrate the spreading of a definite layer over the surface by polishing, and its removal by solvents.

It is further indicated, that polish is the result of surface flow, which itself is due to the solid passing, partly or completely, into the vitreous state. This accounts for the fact that such operations as filing, grinding, etc., produce a thin surface film which differs essentially from the rest of the solid. This surface film is formed by a certain mobility conferred upon the thin layer of

molecules by the instrument used. While in this mobile condition the film behaves like a liquid.

The author attributes the hardening and re-softening of metals in annealing and other processes to the fact that the change from the liquid to the solid states may produce either a crystalline or a vitreous aggregate. Sudden solidification of the mobile layers of ductile metals produced by the flow of the metals can also convert a part of the metal into the vitreous state. This affords a satisfactory explanation for the creaking of metals under strain, that is, of "fatigue."

THE APPLICATION OF THE PRINCIPLES OF EFFICIENCY TO THE TEACHING OF CHEMISTRY.

By J. NORMAN TAYLOR.

George Washington University.

By FAVOUR OF THE AUTHOR.

(Continued from last week.)

SCHEDULES.

Having now made plans, schedules must be employed to assist in the execution of them, and again we go back to a study of the standards which we have established. These, of course, were obtained from a study of records made over a period of time.

Schedules save time and energy, add interest to work, and are a great aid to concentration. Schedules, properly worked out, assure us of an adequate time supply for each task. The late Professor William James, in his "Talks to Teachers," says:

"Your intense, convulsive worker breaks down and has bad moods so often that you never know where he may be when you most need his help. He may be having one of his 'bad days.' We say that so many of our fellow-countrymen collapse, and have to be sent abroad to rest their nerves because they work so hard. I suspect that this is an immense mistake. I suspect that neither the nature nor the amount of our work is accountable for the frequency and severity of our break-downs, but that their cause lies rather in those absurd feelings of hurry and having no time, in that breathlessness and tension, that anxiety of feature and that solicitude of results, that lack of inner harmony and ease, in short,

by which with us the work is apt to be accompanied, and from which a European who should do the same work would nine times out of ten be free. . . . It is your relaxed and easy worker, who is in no hurry, and quite thoughtless most of the while of consequences, who is your efficient worker; and tension and anxiety, and present and future, all mixed up together in one mind at once, are the surest drags upon steady progress and hindrances to our success.

In arranging a schedule for carrying out an experiment in the laboratory, or for a lecture illustrated by demonstrations, there will be listed the equipment necessary, both as to quantity and place and the standard time for the operation.

DESPATCHING.

It is not enough to establish standards, to plan, to write schedules. The things in question must be done, and done at the proper time. In other words, the schedule must be despatched. A good rule for the laboratory and lecture room for both instructor and pupil is, "always begin on time and finish on time." If the schedule is maintained and each operation is despatched promptly, much waste of time will be prevented. Ordering of supplies should be despatched in sufficient time for the goods to arrive before the beginning of the fall term. Despatching of the instructor's reading and studying will prevent the accumulation of too many books and periodicals and will greatly assist the instructor to keep up with the latest and best thoughts of his profession. Aids in dispatching such as bells, gongs, or buzzers, index cards arranged for months and days (sometimes known as "ticklers"), interval clocks, stop watches are valuable and should be freely used. All of these mechanical devices are, however, dependent upon mental training, as efficiency in despatching is essentially a mental quality.

STANDARDISED CONDITIONS.

When the conditions under which the instructor and pupils work have been standardised, the work will be carried on much more quickly and in an easier manner. Much less conscious mental effort is required where standardised conditions obtain. These include lighting, ventilation, maintaining a proper temperature, equipment, and library facilities. It may be of interest to some readers of this paper to note a description by the present writer of the Chemical Laboratory and Lecture Room

at the Washington Y.M.C.A., which appeared in the *Journal of Industrial and Engineering Chemistry* for June, 1920.

Alphabetical or numerical seating of pupils saves time in taking attendance and helps in noting absences. Arrangement of chemicals alphabetically is an excellent procedure. A higher efficiency of assignment will be attained by the instructor, and his time therefore be used to better advantage, if minor details are assigned to some of the pupils. A pupil invariably feels complimented when appointed for the period as a laboratory assistant, and takes a lively interest in getting out and putting away materials, and in seeing that the other students keep things clean.

STANDARDISED OPERATIONS.

It is impracticable to go very far in standardising conditions without first standardising the operations by which the conditions were brought about, and oftentimes we must first break away from tradition before we can properly get on a new and better basis. Standardised operations replace guesswork by accurate knowledge. They are orderly.

As an example to chemistry teaching may be given the arrangement of apparatus in conducting experiments—the proper assembling and setting up of the parts so that they are in "co-ordination." In demonstrating, it is well to arrange apparatus and chemicals in the order in which they are to be used and from left to right.

It will be found if students are instructed to note their laboratory experiments in a uniform manner—as for example (1) Object, (2) Apparatus and Materials, (3) Procedure, (4) Observations, (5) Conclusions or Results—that it will be much easier for the instructor to examine the note books. However, as the note book is the pupil's own record of what he does, the instructor's standards regarding acceptable forms of notation should be flexible. Diagrams accompanying procedure are desirable. Answers to specific questions should be included in the note book.

Professor Munroe's "Scheme for Chemical Recitations" is one deserving of special mention, and the "Freas System" for distributing chemicals in the laboratory is helpful and easily installed. An economy in energy expended in the stockroom and in the accounting department is the ordering of laboratory supplies by multiples of ten.

WRITTEN STANDARD PRACTICE INSTRUCTIONS.

The universal application of the seventh principle is familiar to everyone: school books, technical books, professional and trade journals, mottoes, slogans, recipes, legal forms, style rules and many more are in everyday use.

In connection with the teaching of chemistry—records, plans, schedules, and memoranda for dispatching have created a body of written standard practice instructions.

Perhaps the most notable example is the laboratory manual. The loose leaf system presents a number of favourable features. Included as a part of the loose leaf laboratory manual are sheets setting forth the general rules governing the laboratory; tables, such as the metric tables, the elements with their symbols and atomic weights, solubilities, water vapour pressure; first aid; and textbook references. The type of student in continuation schools, particularly those students attending the Washington Y.M.C.A. presents, on the average, those persons of more mature minds. Accordingly, the direction sheets have been prepared with the particular idea of setting forth, in an elementary way the subject of chemistry in great measure by the laboratory method, and for a class of students more mature than the average high school pupil.

The textbook, another example of written standard practice instructions, is next in value to the laboratory manual. Its proper function is to elucidate the experimental facts and to furnish information that is not accessible to the student by experiment. Of course, the laboratory work should be accompanied by recitations, discussions, and lectures with demonstrations. The experimental facts and common knowledge should be presented, not as isolated things, but to correlate and explain modern theory.

Special instruction sheets may be issued from time to time as occasion demands, and may constitute a part of the laboratory manual. Professor Munroe's method of balancing equations should be in the hands of every chemistry student. Proficiency in working out stoichiometrical problems may be developed by the solution of practical problems submitted to the student at regular intervals. Energy and time may be conserved by enlisting the co-operation of the school office in the matter of multi-graphing the sheets.

Some other examples of written standard practice instructions familiar to chemistry teachers are specifications for making, ordering and purchasing materials and equipment, graphs, charts of organisation, slide rules, formulas for quick calculating, standard methods of analysis, and the various chemists' manuals and annuals.

Concluding the consideration of the seven practical principles, we come to a survey of some of those which Mr. Emerson includes in the moral or ethical ones. In his classification he differentiates those which are mechanical in their applications from those which are basic or mental.

IDEALS.

We are all aware of the value and dynamic worth of high ideals.

We are conscious of the futility of confused ideals. To quote Harrington Emerson, "the vessel that sails for no particular port reaches any port at all only by the rarest accident."

We recognise the waste of wrong or mistaken ideals. Material efficiency must be guided by something more than materialistic ideals. This truth was effectively set forth in the convocation address⁵ by Dr. Charles Alexander Richmond, President of Union College, at the centennial celebration of George Washington University. In speaking of the unwise use of science, he said:

"We have had now something like fifty years of an education which has become more and more absorbed in studying and applying the powers and processes of physical nature. So far as it has applied to man it has been as an interesting and highly diversified animal, rather than as a spiritual being. When we count up our gains and losses we are often perplexed to know on which side the balance lies. Certain large promissory notes have not been made good. Many of our profits are paper profits, and not a few of our securities have gone bad. She has promised us civilisation, she has given us physical comfort; she has promised us emancipation, she has given us efficiency; she has promised us content, she has given us more discontent, by multiplying cravings which she does not and cannot satisfy. As for the promise of happiness,

⁵ Proceedings of the Centennial Celebration of George Washington University, February Nineteenth to Twenty-sixth, 1921, University Bulletin, Vol. XX., No. 1, March, 1921.

that note has certainly gone to protest. The fault is not with science, the fault is our own. We have been asking her to give us that which was not hers to give. * *

It is a subject of Homeric mirth to see the use we make of our time, our energies, our genius, our resources. * *

Never in the history of mankind has he been so utterly the slave of things. * *

The underlying theory of it all, held, as I believe, quite unconsciously, is that the possession of money will emancipate from the bondage of work and enable us to live free and easy lives; and that this is the goal of human aspiration and the only happiness we can be sure of. * * *

To make such a theory the foundation of a system of education and to teach our children in the schools and the young men and women in our colleges that this is life, would be like injecting an insidious kind of poison into them, which would slowly corrupt the blood and in the end destroy all the finer impulses and ideals. * * * My plea to-day is for the safeguarding of these higher values; *a regard* for the ultimate rather than the immediate."

In the younger student, ideals are sometimes held subconsciously. How many of us in sitting at the feet of our teacher have embodied our ideals in him! And some of us may have had an ideal born by a chance word or look or action on the part of our preceptor.

Too much emphasis cannot be laid upon the aims in the teaching of chemistry in high school or college. The following admirably formulated ones are particularly important:

1. To give an understanding of the significance and importance of chemistry in our national life.

2. To develop those specific interests, habits and abilities to which all science study should contribute.

3. The necessity of awakening the minds of our pupils to the possibilities of achievement.⁷

4. The understanding and use of the scientific method of procedure.⁶

5. Acquisition of knowledge which serves as a basis of skills.⁶

⁶Report of the Commission on the Reorganization of Secondary Education. Published in "Treasure Hunting of To-day and Chemistry in Our Schools." Bureau of Education.

⁷Resolutions of the Chemistry Section of the Department of the Interior, Washington. Central Association of Science and Mathematics Teachers. Published in This Journal, March, 1921.

6. To inculcate moral law and to emphasise universal order.

7. To at least, "exercise the pupil in applying standard methods to new problems, with the possibilities that he may learn later to use the same methods in life, and so become a rational and useful citizen."

Attention is directed to the apparent necessity for high school chemistry, in order to be vocational, to include a three year course. College courses in chemistry should be co-ordinated with the preparatory school courses, so that students upon entering college can take up the study of chemistry without repetition of their previous work.

COMPETENT COUNSEL.

Contact with others who are doing the same kind of work, and exchange of ideas is indispensable in any line of work. This is particularly true where the teaching of a growing and advancing science is concerned.

Membership in the American Chemical Society, Chemistry Teachers' Associations, the American Association for the Advancement of Science and other organisations of similar character, attendance upon meetings, conventions, and expositions; and keeping up with the times by subscribing to and reading the current chemical literature are excellent examples of competent counsel.

The school library is an important example of competent counsel. Extensive lists of books suitable for a chemistry library have been issued by the New England Association of Chemistry Teachers and by the Chemistry Teachers' Club of New York City. The American Chemical Society has in preparation reading courses in Chemistry. Subscription to some good periodical on business methods will undoubtedly be advantageous to the chemistry teacher.

A systematically arranged collection of substances that are of interest to students of chemistry is of great help in teaching, as are also occasional trips to manufacturing establishments and to industrial museums and those illustrating natural history.

A departure in museums, of particular interest to the chemical profession, is the Museum of Chemical Types established by the Smithsonian Institution, to fulfil a bequest of the late Morris Loeb. The museum will include original specimens of all new chemical substances and make them avail-

able to research workers for reference purposes.

Other examples of competent counsel are bulletins of the Government Departments, manufacturers' catalogues, Lefax, and chemical dictionaries and encyclopedias.

COMMON SENSE.

Almost indefinable, this quality is one of the greatest value to the teacher.

It is a guide in the choice of ideals, major, minor, and lateral.

It is a guide in the choice of standards.

It is the guide to good judgment—sound, instinctive reasoning.

It is the best guide to all our actions and decisions in the class-room and out.

It can be developed.

Its very essence is *mental alertness*.

The fair deal, discipline and the efficiency reward hardly need any comment. The essential elements underlying the principle of common sense apply to these also. In order to be of the greatest service the chemistry teacher must not only require a fair deal from others, but he must be fair to himself. Too much emphasis cannot be placed upon the value of health culture. Sufficient sleep, proper food with plenty of vitamins, and sufficient recreation are prime considerations.

By all means cultivate a sense of humour. It is a saving grace. "The teacher who can appreciate the humour of a mistranslation, of a ludicrous mistake, of a ready reply, of a disciplinary situation that is at once serious and comic, has a power that will destroy the bitterness of many a heartache and save the day in many a disciplinary crisis. If he is himself something of a humourist, so much the better."

Assiduity in the application of the principles indicated above—always keeping in mind the ideals which we have formulated and allowing common sense to guide us—will bring us our reward; better chemistry teaching; more leisure for self improvement; a greater enjoyment of work and play; and, in larger measure, the ability to both aspire and inspire.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 7167 American Smelting & Refining Co.—Method of treating metallurgical gases. March 10.
- 6843 British Cellulose & Chemical Manufacturing Co., Ltd.—Manufacture of compositions with cellulose derivatives. March 8.
- 7170 Blagdon, J. W.—Manufacture of thymol. March 10.
- 6891 Burt, Boulton & Haywood, Ltd.—Manufacture of colloidal sulphur. March 8.
- 6931 Clark, F. W.—Process of manufacture of gas from coal, etc. March 9.
- 6509 Coles, S. O.—Production of zinc foil. March 6.

Specifications Published this Week.

- 175680 Venditti, Dr. L.—Apparatus for effecting the crystallisation of sugar solutions.
- 175795 Harding, K.—Process for the production of sodium pentaborate from boric ores.
- 156103 Chemische Fabriken Flora.—Process for the manufacture of solver thioglycollate of sodium.
- 156543 Farbenfabriken Vorm. F. Bayer & Co.—Process for separating or isolating organic gases or vapours or organic products.
- 159843 Szarvasy, I.—Apparatus for treating gases with silent electric discharges.

Abstract Published this Week.

Formates of Alkali Metals.—Patent No. 174,125. Messrs. Oldbury Electro Chemical Co., of Niagara Falls, New York, U.S.A., have obtained a patent in this country for a new method of manufacturing caustic alkali solution.

The solution is treated with carbon monoxide in the presence of a finely-divided inert solid initially suspended in the solution. Contact between the gas and the liquid is thus promoted. The solid may be calcium salt containing carbon and oxygen. Calcium carbonate, formed in the manufacture of the caustic alkali solution from sodium carbonate solution and lime, may be left in the solution during treatment with carbon monoxide. Calcium oxalate, precipitated by lime from alkali-formate solution, as described in Specification 160,747, may be similarly employed.

Mercuric Chloride.—Patent No. 172,205.—A new process for obtaining Mercuric Chloride has been invented by Mr. K. Schantz, of 8, Reichstrasse, Freiburg-im-Breisgau, Germany.

The product is produced by dropping mercury through an atmosphere of chlorine into a liquid which does not absorb chlorine. The liquid may be hot water or mercuric chlorine solution, and the temperature may be kept down to about boiling point by adding fresh cold liquid. The apparatus may consist of a rotary drum having blades which lift the mercury and drop it into the liquid, and the chlorine may be introduced under moderate pressure.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on, post free, for the official price of 1s. each.

A Dictionary of Chemical Terms by Couch (D. Van Nostrand & Co., New York) should be available to every chemistry teacher. Brown, John Franklin, "The American High School," The Macmillan Co., New York, 1914.

NOTICES.

EDITORIAL.—All literary communications and Books, Chemical Apparatus, &c., for review or notice to be addressed to the Editor.

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GENTLEMAN desires Appointment in Laboratory; fully qualified in Analysis of Metals, also examination of fuels, water, ores, &c. Highest references, age 21, could take up duties immediately.—Box 852, T. G. Scott & Son, 63, Ludgate Hill, London, E.C.4.

THE OWNERS of British Patent No. 141073, "Compound Anode for Electro Plating and Methods of Making the same," desire to dispose of the Patent or to enter into working arrangements with a firm likely to be interested.

Particulars may be obtained from Hertford Record Co., Ltd., of Lindsey House, 59, Lincoln's Inn Fields, London, W.C.2.



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THE MINISTRY OF AGRICULTURE AND FISHERIES has for disposal, and invites tenders for the purchase of, the contents of an analytical and chemical laboratory, including reagents used in connection with research work at the Rats Research Laboratory, Mount Pleasant, London, E.C.1. There is also a quantity of factory apparatus used for the manufacture of rat bait.

A list of the articles for disposal will be supplied upon application to the Disposal Officer, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

Application for permission to inspect the apparatus should be made direct to the Research Chemist at the Laboratory. (Telephone: City 181).

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3234.

A REVOLUTION IN MEDICAL SCIENCE.

A paper of world-wide interest as affecting the health problems of the age was read at a meeting of the Manchester Section of the Society of Chemical Industry on Thursday, the 30th ult. The meeting was held at the Manchester College of Technology.

The Paper read was on "The Relation between Chemical Constitution and Antiseptic action in the Coal Tar Dyestuffs," by Thomas H. Fairbrother, M.Sc. (Vict.), A.I.C., and Arnold Renshaw, M.D. (Lond.) D.P.H. (Manc. and Cantab.), and dealt with their joint research work on the subject.

The paper is a welcome indication of the success which attends collaboration on the part of the practical industrial scientist, such as Mr. Fairbrother, who is a member of the Technical Research Staff of the British Dyestuffs Corporation, and the investigator of pathological problems, such as Dr. Renshaw, who is a member of the Pathological Staff of the University of Manchester, Pathologist to Ancoats Hospital, and also Bacteriologist for the Manchester Royal Eye Hospital. Both these gentlemen have been doing research work for nearly four years on the antiseptic action of certain dyes on bacteria and the lethal action of the same dyes on protozoa.

The following preliminary general report of the subject matter of the paper has been supplied by the courtesy of Mr. L. Guy Radcliffe, M.Sc.Tech., F.I.C., Hon. Sec. of the Manchester Section of the Society of Chemical Industry.

The work to be described by the authors of the paper has been conducted along lines in which the chemical constitutions of the dyestuffs were carefully considered, and certain dyes have been found which possess powerful antiseptic properties. These dyes are coal tar derivatives and typical members of the different groups of dyes have been examined. Certain dyes of the Azo class show so little antiseptic action that even moulds can grow in them in a concentrated solution. There are, however, other groups such as the triphenylmethane group, the safranines, the

oxazines, and the acridines which exhibit antiseptic properties in varying degrees. Some of these are most powerful antiseptics, preventing the growth of organisms like Typhoid and Anthrax bacilli in dilutions of 1 in 5,000 and killing certain protozoa in dilutions of 1 in 20,000, while the latest results indicate that with certain mixtures of dyes the action in regard to protozoa can be extended to a dilution of 1 in 120,000 of these dyes.

In the paper, the whole field of medicine with the dyes employed, antiseptic action to which diseases, in which known agents are at work, still remain without a definite cure. The present work is along the lines of Ehrlich's Chemio-Therapeutic work which resulted in the preparation of salvarsan. In this work some of the test agents employed were found not to be affected by neo-antiseptic action, 1 in 200, whereas, with the dyes employed, antiseptic action was reviewed, and indications made as 2,000, and, after 15 minutes, in dilutions of 1 in 20,000.

Experiments would appear to indicate that some of these substances may possibly be given even intravenously into human beings, and further work on these lines is being undertaken. Experiments have been conducted on animals with some success. Indications will be given later as to the manner in which medical men now await further chemical advances.

In other words, accurate diagnosis now awaits specific treatment. Thus the known agents of typhoid, dysentery, and cholera can be recognised easily, to mention only a few, while with tropical diseases there is a vast field to explore in such cases as malaria, sleeping sickness, kala azar, and filariasis, with regard to which really, with the exception of malaria, very little has been done, and even in the case of malaria a better agent than quinine may be found.

Modern medicine will undoubtedly have to progress along the lines of applying a precise specific chemical substance to kill off a known infective agent. This is already done in some diseases, such as diphtheria, where diphtheria antitoxin can be given, and such as syphilis in which salvarsan is used, but this merely represents the fringe of the field which is yet to be explored. When this work can be done, the amount of suffering in the world can be enormously reduced by killing the infective agent in the early stages before gross damage to tissues has resulted.

The British Dyestuffs Corporation, Ltd., Blackley, have shown great interest in the work undertaken by the authors of the Paper and of whom, as has been already stated, is a member of their Technical Research Staff. The firm are affording every facility in their power to the investigators with a view to making the results obtained of great practical value to the medical profession and to the general public.

POLYMERISATION AT THE CRITICAL TEMPERATURE.

By Wm. E. Fiddling, M.A., M.Sc., Fici., Senior Science Master at King Edward VII. School, Liphua.

NOTE.—The data used in this paper have been taken from Landolt-Börnstein's Tables, and the paper is a continuation of "Polymerisation amongst Liquids," *Chem. News*, 1921, Vol. 122, p. 289.

There are not many data available for the study of specific heats under pressure; hence the difficulty of deriving a reliable formula connecting the degree of polymerisation and critical constants.

Let us first take the case of ether, in order to discover the influence of pressure alone on the degree of polymerisation, the temperature remaining constant. We have for ether:

Temp.	Press.	Sp. Ht. (observed).
303	1	0.547
448	50	1.128
448	300	0.976

At 448° the specific heat decreases from 1.128 to 0.976 as the pressure is increased from 50 to 300 atmos. Now the specific heats of polymerised water at 273° A. were calculated (*Chem. News*, 1921, Vol. 122, No. 3,193, p. 292) to be:—

(H ₂ O) ₃ (ice)	0.5
(H ₂ O) ₂	0.945
(H ₂ O)	1.890

so that ether, under the higher pressure, is likely to be more polymerised than under the lower. The vapicular weight corresponding to 418° A. is about 257 (*Chem. News*, 1921, Vol. 122, No. 3,193, p. 290), from which

$$R = 2.64$$

$$s \text{ (calc)} = 2.576$$

$$\therefore p \text{ (50 atmos.)} = 2.29$$

$$p \text{ (300 atmos.)} = 52.1$$

That is, p is increased by 0.35 for an increase in pressure of 250 atmos., or an

average increase in p of only 0.0014 for atmosphere increase of pressure. Thus, at the critical point where

$$T_c = 467$$

$$P_c = 36$$

p for ether will be about 2.10.

Water. — Landolt-Börnstein gives two series of specific heats for water, at temperatures above 373° A. Regnault's values for temperatures above 373° are considerably less than Dieterici's, but unfortunately only go to 453° A., so I have calculated p at the higher temperatures from the latter values.

T	Vap. Wts.	s (Regnault).	s (Dieterici).	p
373	209	1.0122	1.0099	2.06
453	261	1.0355	1.0482	
473	277		1.0619	2.03
573	342		1.1543	1.90
647 (C.T.)			1.28 (graph)	1.5-1.742

Graphing p from Dieterici's specific heats, and bearing in mind the lower trend of Regnault's values which would make p higher still [$s \text{ (calc)} \div s \text{ (observed)}$], I concluded that p for water at the C.T. would be about 1.74.

Amylene.—The following data are available:—

T	P	s
448	50	1.019
448	300	0.889

$$\text{Vap. Wt.} = 257.$$

$$R = 55$$

$$s \text{ (calc)} = 2.719$$

$$\therefore p \text{ (50 atmos.)} = 2.66$$

$$p \text{ (300 atmos.)} = 3.06$$

Thus, one atmosphere pressure raises p by 0.0016 (cf. ether).

At the critical temperature,

$$T_c = 476$$

$$P_c = 40$$

$$\therefore p \text{ will be about } 2.50.$$

The values of p at the critical temperature so far obtained are:—

	C.T.	C.P.	d _c	p.
Water	647	217.5	0.329	1.5-1.74
Ether	467	36	0.26	2.10
Amylene	476	40		2.50

These values, as one would expect, are intermediate between the values at the boiling-point (atmos. press.) and in the gaseous state.

The following equation not only gives the above values for p , but also what seem to be not unlikely values for other sub-

stances,

$$p = \frac{MP_c}{k d_c T_c}$$

where M is the formula weight.

p is the degree of polymerisation at T_c

d_c is the critical density.

P_c is the critical pressure.

T_c is the critical temperature.

$$\therefore k = \frac{M P_c}{p d_c T_c}$$

Substituting data for ether,

$$d_c = .26$$

$$P_c = 36$$

$$T_c = 467$$

$$M = 74$$

$$p = 2.1$$

$$\therefore k = 10.5$$

Thus, the general formula is

$$p = \frac{M P_c}{10.5 d_c T_c}$$

Guye (Ann. Chim. Phys.: 1892, (6), 26, 97) derived the equation:

$$\frac{M}{28.87} = \frac{1146 d_c T_c}{P_c (T_c + 1070)}$$

but, my results do not agree well with his. In fact, his "molecular" weights (i.e., polymeric weights) often come out less than the formula weight (e.g., Xenon).

N.B.—To get my values for elements, I have substituted the atomic weight in my equation. E.g., each argon atom becomes $(A)_{2.36}$ at the critical temperature, and each hydrogen molecule, H_2 , is still H_2 at its critical point. See Table I.

Chem. News: 3: Polymerisation at the Critical temperature, Continued

TABLE I.

Substance	d_c	T	P	Formula Weight	p
Br ...	1.18	575	129?	80	1.44
H ...	0.033	32	11	1	0.99
O ...	0.43	155	50.8	16	1.15
N ...	0.327	127	33	14	1.05
A ...	0.509	151	48	39.9	2.36
Kr ...	0.775	210	54.3	82.9	2.61
X ...	0.92	288	57.2	130.2	2.60
N_2O ..	0.454	312	77.5	44	2.28
CO_2 ...	0.46	304	73	44	2.17
SO_2 ..	0.52	430	78	64	2.11
H_2O ..	0.429	647	217.5	18	1.34
	0.329	647	217.5	18	1.43
$SnCl_4$	7419	592	37	261	2.09

Before calculating p for some of the organic compounds, it is interesting to compare the specific heats of a few substances in the liquid and gaseous states at, or near, the critical temperature. First, take the case of gaseous N_2O . At the C.T., as the pressure is increased, the gas is approximating to the liquid state, until when the C.P. is reached the identity of the gas is merged in that of the liquid, i.e., the fluid is homogeneous and p is likely to be greater than 1.

Liquid State.	$T_c = 312$
	$P_c = 77.5$
	$p_c = 2.28$
	$s_c = 0.3528$
Gaseous state.	$T = 300-473^\circ$. Avgc Temp = 386°
	s (at const. Press) (1 atmos) 0.225
	(... ..) (30 ..) 0.278
	(... ..) (77.5 ..) 0.344

The last value, s under a pressure of 77.5 atmos., in the gaseous state, is obtained by plotting specific heats against pressure and producing the graph as a straight line to the C.P.,

$$\text{i.e., making } \frac{P_3 - 1}{P_2 - 1} = \frac{s_3 - s_1}{s_2 - s_1}$$

where s, is the specific heat of the gas at constant (atmospheric) pressure. Note the ratio,

Observed sp. heat of gaseous N_2O at T.
sp. heat of liquid N_2O at C.T.

The temperature, T_c , should be the critical temperature, but I have had to accept some results at a slightly different temperature. See Table II.

TABLE II.

	T	P	s	spec. heat.	
				sp. ht. at C.T.	
Gas	386	1	0.225	0.636	1
	"	30	0.278	0.788	1.24
	"	77.5	0.344 (graph)	0.975	1.53
Liquid	312 (C.T)	77.5	0.3528	1	1.57++

If the specific heats in the gaseous state had been determined at 312° (as in the liquid state) they would have been less, so that the last value, 1.57, should be 1.57++.

Carbon Dioxide, CO_2 .

$$T_c = 304$$

$$P_c = 73$$

$$S_c = 0.369 \text{ (liquid)}$$

$$p_c = 2.17$$

TABLE III.

		specific heat of gas at T.			
		T	P	s	sp. ht. of liquid at C.T.
Gas	{	293	1	.202	.547
		..	30	.267	.723
		..	73	.342 (graph).	.927
Liquid		304	73	.369	1
Methane, CH ₄ .					

$$T_c = 191$$

$$P_c = 55$$

$$d_c = .23 \text{ (By analogy with pentane, etc.)}$$

$$p_c = 1.90$$

$$s(\text{scale}) = s(\text{scale}) = 3.19$$

$$p(\text{probable}) = 1.68 \quad [\text{Liquid.}]$$

TABLE IV.

		Spec. ht. of gas at T.			
		T	P	s	sp. ht. of liquid at C.T.
Gas	{	..	1	0.591	0.352
		..	55	0.84 (graph)	0.500
		..	30	0.692	0.412
Liquid		191	55	1.68	1

(To be Continued.)

CHEMICAL NOTES.—BOTANICAL.

I. ANALYSES OF SOME AUSTRALIAN FRUITS.

By THOS. STEEL.

1. *Eupomatia laurina* R.Br.

This is a tall, Laurel-like shrub bearing urceolate, succulent, sub-acid fruits. Ripe fruits were selected from a plant growing in Sydney Botanic Gardens, June 11th, 1897.

2. *Ficus macrophylla* Desf. Moreton Bay Fig.

Largely cultivated for shade and ornamental purposes, bears quantities of

purple, globular fruits, about 1 inch in diameter. These are much sought after by the Great Fruit Bat or "Flying Fox" which comes into the cities at night to feed on them. From a tree growing at Petersham, near Sydney.

3. The same, from trees in Sydney Domain; in both cases ripe fruit collected in May, 1897.

4 and 5. *Ficus Cunninghamii* Miq. Sydney Botanic Gardens.

Ripe fruit collected May, 1898.

6. *Ficus rubiginosa* Desf.

Unripe fruit from Sydney Botanic Gardens, May, 1898.

7. Edible Fig, purchased in Sydney. For comparison.

8 and 9. *Podocarpus elata* R.Br.

The fleshy fruit-stalks which carry the hard nut-like fruit on top and have given rise to popular statements about Australian cherries with the seed outside. The entire fruit is swallowed by birds, the soft stalks being digested and the hard seed dropped wherever the bird chances to go, thus insuring distribution. The fleshy stalks were separated, pulped and analysed. Of the entire fruit, 47.7 per cent. was stalk and 52.3 seed. The average weight of one stalk was 1.3 gram. Cane sugar was absent, the sugars present being the usual constituents of Fruit sugar, dextrose and levulose. Collected June, 1897, two samples. The pulped fruit-stalks have a fine rich purple colour, soluble in water or spirit, and yielding a brilliant claret coloured liquid which turns blue with alkalies.

The method used in analysing these fruits is described under 'Fijian Wild Sugar Cane' below.

	1	2	3	4	5	6	7	8	9
Dextrose	2.05	5.75	6.77	4.07	3.30	0.30	5.65	2.56	2.00
Levulose	1.70	4.84	5.69	2.97	2.98		4.07	2.59	1.94
Seeds, fibre, pectose, &c.	17.98	20.24	19.88	8.89	10.50	24.37	3.34	39.20	40.65
Ash	1.42	1.90	1.64	1.11	0.97	2.30	0.44	0.84	0.41
Water	76.85	67.27	66.02	82.96	82.25	73.03	86.50	54.81	55.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Nitrogen

0.16 0.29 0.25

1. *Eupomatia laurina*.6. *Ficus rubiginosa* (unripe).2, 3. *Ficus macrophylla*.

7. Edible fig.

4, 5. *F. Cunninghamii*.8, 9. *Podocarpus elata* (Fruit stalks).

II. FIJIAN WILD SUGAR CANE.

The banks of the fresh water rivers of Fiji are covered with a dense tangled growth of a long, slender cane. It is called Vico (Pronounced Vitho in Fijian) by the Fijians, but so far as I know, no use is made of it. There are two varieties, red and yellow. Mr. E. Cheel, who examined it in Fiji informs me that botanically he considers it to be a variety of *Saccharum officinarum*, the common sugar cane.

In November, 1885, when the cane was ripe, I made analyses of four samples. For purposes of comparison I give an analysis, made at the same date, of native cane cultivated by the Fijians and known as Anani, also one of a representative sample of introduced cane of the variety named "Honolulu," at that time largely grown in Fiji for the supply of the sugar mills. The native cane, Anani, is apparently indigenous; at any rate it is the variety grown by the natives for a very long time past, before the advent of Europeans. At the time of my residence in Fiji, about 1885-1886, it was preferred by the Fijians for food purposes to any of the introduced varieties, although these were sweeter. This was probably because they had always used it and were accustomed to it. The method of use was to grate the cane to pulp on a piece of rough coral and squeeze out the juice, which was then used for sweetening purposes.

The analyses are as follows:—

		Fijian Wild Cane.				Sugar Canes.	
		Red.		Yellow.		'Anani'	'Honolulu'
Soluble in water	Cane Sugar	3.33	1.68	3.16	3.27	10.88	15.08
	Fruit Sugar	1.00	1.68	0.97	0.74	0.52	0.61
	Other organic matter	1.37	1.56	1.71	1.58	1.73	0.80
	Ash	1.35	1.08	1.39	1.11	0.26	0.17
Insoluble	Fibre	22.48	18.46	26.15	27.08	15.54	11.98
	Ash	0.24	0.22	0.35	0.44	0.36	0.32
	Water	70.89	75.80	66.80	66.38	71.52	70.52
		100.66	100.48	100.53	100.60	100.81	99.48
Average weight per stalk. Kilog.		0.38	0.61	0.44	0.51	—	1.51

The Fruit sugar in these canes consists of about equal proportions of detrose and levulose.

The method of analysis followed was that of diffusion. In preparing the sample of cane for analysis the stalks were quartered lengthwise and one complete section from each stalk was chopped into short lengths which were pulped by passing through a meat mincing machine, the pulp so obtained being well mixed and the requisite quantities quickly weighed off. A known weight of pulped cane was put into a tared flask with sufficient water, the flask, fitted with a cork and a plain long tube as a return condenser, was placed in a vessel of boiling water and shaken at frequent intervals for one hour. The flask and contents were then cooled and weighed, and the amount of added water thus ascertained. The liquid was then strained off through a fine cotton cloth and analysed. The percentage of fibre and water in the original pulp having been determined and the Sp. Gr. of the diffusion liquid ascertained, the total weight of liquid derived from added water and that in the pulp taken is thus readily found. The liquid being analysed, it is a simple matter to calculate the total constituents present and to compute therefrom the percentages in the original pulp. 200 grammes pulp and about 400 of water are convenient quantities to use.

In examining the fruits mentioned above, they were passed direct through the meat

mincing machine and the diffusion conducted as far as time. 200 grammes pulped fruit and 350 to 350 of water proved suitable proportions. In fruits the direct determination of matter insoluble in water is not always practicable owing to the glutinous nature of the pulp and the imperfect solubility of the pectin bodies. In these, therefore, the total of these constituents was taken by difference which is sufficient for all essential purposes.

III. ROOTS OF DRAGON TREE, *Cordyline terminalis*.

In Fiji the long conical roots of the

	Raw
Soluble in Water	
Levulose	3.32
Ash	0.27
Inulin, &c.	30.19
Insoluble Fibre	11.59
Ash	0.59
Water	52.98
	98.94

Weight of root. Kilogs. 1.64

It will be noticed that the raw root was found to contain a small proportion of levulose, it also contained numerous raphides but no starch.

Dr. George Bennett (Gatherings of a Naturalist, 1840, p. 397) states that the root of the Ti (*Dracaena terminalis*) contains a large quantity of saccharine matter, from which the natives of Tahiti extract a coarse sugar; they likewise bake and eat the root, from which also a spirituous liquor is distilled. As will be seen from the analyses above the sugar is only present after cooking.

Speaking of the same root, H. S. Cooper (Coral Lands, Vol. ii., 1880, p. 170) says: "In the Friendly Islands, as well as in all other neighbouring groups, great quantities of the ti or dragon-tree are found. The root when cooked contains a most extraordinary quantity of saccharine matter; indeed it seems as if it had been boiled in syrup. Rum is distilled from it in the Friendly Islands as well as from the sugar cane."

IV. DEPOSIT OF CALCIUM CARBONATE IN TIMBER OF GEISSOIS BENTHAMII (F. v. M.).

Some time ago I received from Mr. Maiden a specimen of timber of Red Carabeau, *Geissois Benthamii* (Bentham)

Dragon tree (*Cordyline terminalis*), known by the natives as Vasili dinu (Pronounced ndinu in Fijian) and Vasili tagu (Pronounced tangu in Fijian), are, after roasting, used as food. Prior to cooking, the roots are white and contain a large proportion of inulin which during the process of roasting becomes transformed into the sugar levulose. After roasting, the roots are soft, succulent and black, looking as if they had been soaked in molasses. The dark colour is due to caramelisation of part of the levulose.

	Roasted.	
	1	2
Levulose	38.53	40.49
Caramel, &c.	10.85	6.93
Ash	0.58	0.58
Fibre	12.58	14.06
Ash	0.42	0.68
Water	38.00	38.64
	100.96	101.38
	2.08	1.30

(F. v. M.), coated in places with a rather hard flinty-looking mineral deposit. This is referred to by Mr. Maiden (Forest Flora of N.S. Wales, VI., 1917, p. 208) as being a source of trouble to saw-millers in the Dorrigo (N.S. Wales), where it is known as "flint." It occurs in the heart of the logs and causes injury to the saws. The suggestion is made that the deposit may be siliceous. Chemical examination showed that it consists of pure calcium carbonate. The amount of deposit at my disposal was insufficient to allow of a quantitative analysis, but qualitative tests disclosed no other substance present. A few chips of the timber carrying the deposit, and of the same, in so far as could be seen, quite free therefrom, were submitted to analysis:—

Timber of *Geissois Benthamii* (Air-day).

	Free from	Free from
	Incrusted portion.	visible incrustation
Ash (CO ₂ free) ...	11.4	0.97
Lime (CaO)	10.2	0.31
equal to Calcic carbonate	18.2	0.55
Water	—	9.6

I have not noticed any previous record of the occurrence of this substance in a timber, though its existence as crystallites in the bark of *Ficus* and some other plants

has been noted (H. G. Smith, Journ. Royal Soc. N.S. Wales, xxxix., 1905, p. 29).

V. THE NITROGEN CONTENT OF FUNGI.

In June and July, 1897, I examined a number of Australian fungi for nitrogen. Three of these were freshly collected on the Blue Mountains, N.S. Wales, and identified by Mr. R. T. Baker; others were ordinary dried herbarium specimens from the collections in the Technological Museum, Sydney, given to me by Mr. Baker. The *Polyporus mylittae* C. et M. (*Mylitta australis* Berk.), popularly known as "Blackfellow's bread," was collected at Wentworth Falls, N.S. Wales, and consisted of a sclerote weighing 2416 grams. The results obtained are as follows:—

Percentage of nitrogen in Australian fungi (dry).

<i>Peziza fasciculosa</i>	6.86
<i>Stereum caperatum</i>	1.83
„ <i>lobatum</i>	2.40
<i>Polyporus mylittae</i>	0.51
„ <i>portentosus</i>	2.47
<i>Hexagona subtenuis</i>	1.16
„ sp.	2.16
<i>Lenzites repandra</i>	1.12
<i>Polystictus flabelliformis</i>	0.70
„ <i>sanguineus</i>	2.40
<i>Trametes Muelleri</i>	0.52
„ <i>lactinea</i>	2.21
<i>Clathrus cibarius</i>	1.99
<i>Xylostroma giganteum</i>	0.30

X. giganteum really consists of the sterile mycelium of several Polyporaceae, chiefly *P. eucalyptorum* and a species of *Fomes*.

The three fresh specimens, as under, contained respectively of water:—

	% Water
<i>Peziza fasciculosa</i>	95.9
<i>Clathrus cibarius</i>	93.5
<i>Polyporus mylittae</i>	77.2

The moisture in the herbarium specimens varied from 10 to 15 per cent. *P. mylittae* in its fresh state yielded 0.15 per cent. ash.

In a paper on *P. mylittae* by Mr. J. H. Maiden (Agric. Gaz. N.S. Wales, iv., 1893, p. 909) it is stated to contain no nitrogen in any form. The specimen examined by me certainly contained nitrogen, though by comparison with some of the other fungi the amount is not high.

The method used for the nitrogen determinations was the Kjeldahl-Gunning.

VI. EXUDATION FROM MYOPORUM PLATYCARPUM R.Br.

In January, 1921, there was forwarded to Sydney Botanic Gardens a sample of a dark brown sugary-looking mass which had been found by Mr. P. Webb in a hollow trunk of the above tree at Barton, S. Australia. This was kindly handed to me by Mr. Maiden for investigation. Examination showed it to consist of impure mannitol from which the pure substance could be readily obtained by extraction with hot alcohol, the mannitol crystallising out on cooling.

A similar exudation from a tree of the same species was obtained during the Elder Exploring Expedition to Central Australia. This was analysed by Mr. H. G. Smith, and the results published by Mr. Maiden (Trans. Royal Socy., S. Aust., xvi., 1892, p. 1).

For the analysis of the Barton sample I am indebted to my colleague, Mr. E. F. Vaughan. For the purposes of comparison I have placed the figures of both analyses together:—

	Elder Expedition. Cent. Australia.	Barton S. Australia.
Mannitol	89.65	44.0
Reducing sugar	2.87	5.4
Other sugars	0.51	—
Gums, insol- uble, &c.	2.37	10.8
Ash	1.10	1.9
Water	3.50	7.9
	100.00	100.0

The exudation is known to occur from punctures made by insects.

The Barton sample resembled lumps of coarse raw cane sugar and contained somewhere about 10 per cent. of insoluble matter, principally vegetable debris. It had evidently undergone some deterioration. Barton is a station on the East-West Railway Line crossing the Australian desert.

(From the Proceedings of the Linnean Society of New South Wales, 1921, Vol. xli., Part 4, 26th October, 1921.—By favour of the Author).

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, MARCH 23, 1922.—

Sir Charles Sherrington, President, in the Chair. The following papers were read, the Summaries here printed having been supplied by the authors for use at the Meeting:—

SIR RICHARD CLIFFEEROCK, F.R.S. *Specific Heats of Air, Steam and Carbon Dioxide.*

In a recent number of the "Proceedings of the Society" is a paper by Mr. Womersley dealing with the specific heats of air, steam and carbonic acid at high temperatures. Mr. Womersley's experiments extend over the range 1000°C. to 2000°C. , but he gives a table of the volumetric heats from 0°C. to 2000°C. in which the values below 1000°C. purport to be those obtained by Holborn and Hemming.

The object of the present communication is to point out that the values here given are in all cases higher by some 5 per cent. to 10 per cent. than those which follow from the results tabulated by Holborn and Hemming in their well-known paper in the "Annalen der Physik" for 1907, vol. xxiii., p. 842.

A. E. H. TUTTON, F.R.S. (1) Monoclinic Double Selenates of the Manganese Group; (2) Monoclinic Double Selenates of the Cadmium Group.

(1) In this memoir are described the results of the investigation of the crystals of the manganese group of double selenates of the isomorphous series $\text{R}_2\text{M}(\text{SeO}_4)_2 \cdot 6\text{H}_2\text{O}$. It includes only three salts, those in which R is rubidium, caesium, and ammonium. For the potassium salt has not been obtained, and appears, like its sulphate analogue, to be incapable of existence. The ammonium salt was measured by Topsøe, but not optically investigated, and the rubidium and caesium salts have not been hitherto described at all.

The results are precisely in line with those for the analogous salts of the other groups which have been dealt with by the author in previous memoirs, so that if the potassium salt could be obtained there could be little doubt that it would fall into line as the first member of a progressive series, and that the general law of progression of the crystallographic properties with the atomic number of the alkali metal would be obeyed as rigidly as in the other

groups already described. It is possible, indeed, to predict the properties which the potassium salt would possess.

Ammonium manganous selenate hexahydrate proves to be almost exactly isostructural with rubidium manganous selenate, the volume and edge-dimensions of the space-lattice cells of the crystal structures of the two substances being very nearly identical. A similar fact has been shown to obtain for all analogous ammonium and rubidium salts throughout the whole isomorphous series, as well as for the rhombic simple sulphates themselves.

(2) This cadmium group has proved a very difficult one. Crystals of the ammonium salt $(\text{NH}_4)_2\text{Cd}(\text{SeO}_4)_2 \cdot 6\text{H}_2\text{O}$ were measured by Topsøe, but no optical investigation was possible as the crystals were "porcelain like." After very many attempts some crystals have been obtained by the author on very keen frosty nights, which were sufficiently transparent in parts for optical use, and by adopting a rapid method, similar to that used for the equally difficult potassium ferrous selenate, a complete determination of the optical constants has been accomplished. The potassium salt, however, has resisted all efforts, and appears incapable of existence (its limit being probably below 0°C.), like its sulphur analogue. For a long time also no crystals of the rubidium or caesium salt could be obtained, but eventually during the coldest nights of January a few crystals were obtained among others with different water of crystallisation. They were quite opaque however, from the first, so that only goniometrical measurements were possible.

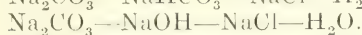
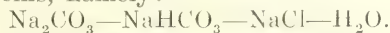
The results, as far as they go, are in complete accord with those derived from other, complete, groups, as in the case of the manganese group described in the preceding memoir.

This communication completes the great work which the author set before himself in the year 1890, namely, a thorough crystallographic investigation of the two most important series of isomorphous salts, the rhombic sulphates and selenates of the alkalies and the monoclinic hexahydrated double sulphates and selenates containing the same alkali bases, potassium, rubidium, caesium, ammonium and thallium. Seventy-five salts have been investigated, the work having involved over forty-five thousand

goniometrical measurements, five hundred density determinations, and the preparation and use in the optical measurements of over a thousand section-plates and 60°-prisms.

F. A. FREETH. The System: $\text{Na}_2\text{O}-\text{CO}_2-\text{NaCl}-\text{H}_2\text{O}$. Communicated by Prof. F. G. Donnan, F.R.S.

The above system is arbitrarily considered as being composed of two four-component systems, namely:—



Determinations have been made at eight different temperatures, namely, 0°, 15°, 20°, 25°, 30°, 35°, 45° and 60° C.

A general treatment is given showing how the composition and quantities of the stable phases which are formed from any mixtures whatsoever of the components may be deduced.

M. A. CATALAN. Series and other Regularities in the Spectrum of Manganese. Communicated by Prof. A. Fowler, F.R.S.

Flame-arc, arc and spark spectra of manganese have been experimentally observed and series lines traced additional to those previously known. Series belonging to the spectrum of the neutral atom are (1) a system of triplet series (sharp, diffuse, principal and fundamental); (2) a system consisting of narrow triplets (sharp, diffuse, principal); and (3) a system of narrower triplet series running parallel to the preceding system. The last two systems are analogous to the singlet systems in the alkaline-earths. Intercombination lines between the two first systems, $1\text{S}-1p_{2,3}$, have been detected as two lines very prominent at low temperatures. The ionisation and resonance potentials of manganese, as calculated from 1S and $1\text{S}-1p_2$ are 7.4 volts and 2.3 volts respectively.

In the spectrum of the ionised atom no series have yet been traced, but there are indications of two systems of triplet series of same types as found in the arc spectrum. In each case the diffuse triplets are composed of *nine* lines, giving *five* values to the *d* term, instead of *six* lines and *three* values as in the alkaline-earths.

By observations of spectra at different temperatures, groups of lines of the same character and related by very exact numerical separations have been identified, and the name "multiplets" is suggested for these groups. Such multiplets have also

been noted in other spectra, and may serve to indicate the most probable nature of series in spectra where actual series have not been traced.

The spectrum of manganese in relation to the periodic table is discussed. It seems possible that the neutral atom has two electrons in the outermost ring, and that when it loses one electron, thus becoming ionised, another electron comes out to this ring, which again possesses two. Thus, the spectra of neutral and ionised atoms would be similarly constituted, in accordance with observations.

D. W. DYE, B.Sc. Calculation of a Standard of Mutual Inductance and Comparison of it with the similar Laboratory Standard. Communicated by Sir J. Petavel, F.R.S.

A copy of the Campbell type of Mutual Inductance Standard has been constructed by Mr. R. W. Paul for the Japanese Government.

The windings of the primary helices and the secondary overwound coil were carried out at the National Physical Laboratory. The length measurements of these windings were made in terms of the length standards of the Laboratory. From these measurements and the numbers of turns in the windings the value in absolute millihenries has been calculated, taking account of the small irregularities of the windings.

Comparisons between this standard and the similar Laboratory standard have been made at a frequency of ten cycles per second.

The ratio of the calculated values of the two standards was found to be in agreement with the ratio of the experimentally compared values to an accuracy of five parts in a million.

The probable accuracy of the value calculated from dimensions was estimated as 2 parts in 10.

Curves are given showing dimensions and irregularities of the windings and of the variations in mutual inductance with variations in the dimensions of the windings.

P. E. SHAW and N. DAVY. The Effect of Temperature on Gravitative Attraction. Communicated by Prof. E. H. Barton, F.R.S.

One of the writers (*see* Shaw, "Phil. Trans.," May, 1916) has already published results with a torsion balance of the Boys-Cavendish type, which indicated a temperature effect of gravitation of about 1×10^{-10} per 1°C . The present paper is an account of a new series of experiments identical in principle with the former ones; but the apparatus is now stronger and in some respects more elaborate than the old one. It has been modified in this way to eliminate, if possible, any small mechanical movements in the apparatus which may be caused by the raising of the large gravitative masses to a high temperature. If these movements were reversible with temperature, spurious effects might arise which would account for the previous results.

The experiments have been successful in the sense that the modifications in the apparatus have shown that most, or all, of the effect found in the previous research was indeed due to such reversible movements. The temperature effect, if any exist under the conditions of the experiment, is now given as less than 2×10^{-10} per 1°C . The mean effect now observed is a very small diminution in attraction as temperature rises.

A cablegram was read from Prof. J. C. McLennan stating that he had observed accompanying the ordinary red lithium doublet, a second doublet, 0.28 Angström units to the violet—three times the displacement predicted by Merton for the lithium isotopes.

THURSDAY, MARCH 30, 1922. At 4.30 p.m.—Papers Read.—The late W. G. Ride-wood, D.Sc. Observations on the Skull in Fœtal Specimens of Whales of the General *Megaptera* and *Balaenoptera*. Communicated by Prof. E. W. MacBride, F.R.S.

W. L. Balls. Further Observations on Cell-Wall Structure as seen in Cotton Hairs. Communicated by Dr. F. F. Blackman, F.R.S.

L. T. Hogben and F. R. Winton. The Pigmentary Effector System. 1.—Reaction of Frog's Melanophores to Pituitary Extracts. Communicated by Prof. E. W. MacBride, F.R.S.

Agnes Arber, D.Sc. On the Development and Morphology of the Leaves of Palms. Communicated by Prof. F. W. Oliver, F.R.S.

H. E. Roff. The Acidity of Muscle dur-

ing Maintained Contraction. Communicated by Sir Charles Sherrington, P.R.S.

List of probable papers for reading, April 6th, 1922:—

F. E. Smith, F.R.S.—On an Electromagnetic Method for the Measurement of the Horizontal Intensity of the Earth's Magnetic Field.

G. I. Taylor, F.R.S. Stability of a Viscous Liquid contained between two Rotating Cylinders. Part I.: Theoretical. Part II.: Experimental.

Prof. T. H. Havelock, F.R.S. Dispersion Formulae and the Polarisation of Scattered Light: With Application to Hydrogen.

G. R. Goldsbrough, D.Sc.—The Cause of Encke's Division in Saturn's Ring. Communicated by Prof. T. H. Havelock, F.R.S.

C. Spearman.—Correlation between Arrays in a Table of Correlations. Communicated by Prof. L. N. C. Filon, F.R.S.

Dr. W. L. Balls.—Apparatus for determining the Standard Deviation Mechanically.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, THURSDAY, 6TH APRIL, 1922, AT 8 P.M.—The following papers were read:—

Constitution of picrocellin, a nitrogenous constituent of *Roccella fuiformis*.—M. O. Forster and W. B. Saville.

The determination of surface tension from the maximum pressure in bubbles.—S. Sugden.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

PASTEUR CENTENARY. STRASBOURG—MAY-OCTOBER, 1923.

In order to commemorate the Centenary of the birth of Pasteur, the University and the town of Strasbourg, with the concurrence of the Pasteur Institute, and the approval of the family of Pasteur, have proposed to erect a statue facing the Strasbourg University where, as a professor, Pasteur commenced his career.

The inauguration ceremonies will take place on May 1st, 1923, under the Patronage of M. A. Millerand (President of the Republic), M. le Président A. Loubet, M. R. Poincaré, M. Leredu and M. Alapetite, and will include the unveiling of the statue, and the opening of an Exhibition of Hygiene and Bacteriology. This Exhibition

will be designed to illustrate the advances made in various branches of science as the result of Pasteur's discoveries, and at the same time, a Congress of Hygiene and Bacteriology will be held for the discussion of questions relating to the prevention of disease.

With the object of showing the sympathy of this country with the projects of the French Committee, a British Committee composed of the following members has been formed:—

Sir Charles Sherrington, G.B.E., President of the Royal Society (Chairman).

Mr. A. Chaston Chapman, F.R.S., President of the Institute of Chemistry of Great Britain and Ireland (Treasurer).

Mr. H. E. Field, President of the Institute of Brewing.

Prof. Percy F. Frankland, C.B.E., F.R.S., Emeritus Professor of Chemistry, University of Birmingham.

Sir John M'Fadyean, M.R.C.V.S., LL.D., Principal of the Royal Veterinary College.

Prof. C. J. Martin, C.M.G., F.R.S., Director of the Lister Institute.

Sir W. J. Pope, K.B.E., F.R.S., Professor of Chemistry, University of Cambridge.

Sir James Walker, F.R.S., President of the Chemical Society.

Sir Almroth Wright, K.B.E., F.R.S., Principal of the Institute of Pathology and Research, St. Mary's Hospital.

It is hoped that those who desire to contribute to the Memorial will send their contributions to the General Secretary and Treasurer, Monsieur Th. Héring, 6, rue des Veaux, Strasbourg; or to Mr. A. Chaston Chapman, F.R.S., The Instituté of Chemistry, 30, Russell Square, London, W.C.1.

The Commissioner-General, Professor Borrel, is very anxious to be furnished with the names of manufacturers and business firms in this country to whom the Exhibition might be of especial interest. All who can assist are requested to communicate with Professor Borrel, 3, rue Koeberle, Strasbourg.

ROYAL INSTITUTION.—Lectures at the Royal Institution after Easter will be resumed on Tuesday, April 25, when Sir Arthur Keith will begin a course of three further lectures on "Anthropological Problems of the British Empire," Series II., "Racial Problems of Africa." The Tyndall lectures will be delivered this year by

Prof. W. Bulloch on "Tyndall's Biological Researches," and "The Foundations of Bacteriology," and Sir Percy Sykes will give two lectures on Persia. On Thursday afternoons there will be two lectures by Prof. E. H. Barton on "Audition and Colour Vision"; two by Prof. F. Keeble on "Plant Sensitiveness." On Wednesday, May 24, Dean Inge begins a course of three lectures on "Theocracy"; and on Wednesday, April 24, Prof. D. H. MacGregor gives the first of two lectures on "Industrial Relationship." On Saturday afternoons there will be two lectures by Prof. C. W. Richardson on "The Disappearing Gap between the X-ray and Ultra-Violet Spectra," and three by Sir Hugh Allen on "Early Keyboard Music," with musical illustrations by Mr. Harold Samuel. The Friday Evening Discourses will be resumed on April 28, when Dr. Arthur Harden will deliver a lecture given by Dr. M. Grabham, Dr. H. H. Dale, Sir William Bragg, Prof. W. E. Dalby, the Hon. Maurice Baring, Mr. J. Barcroft, and other gentlemen.

THE INSTITUTE OF METALS.

A ballot for the election of members and student members of the Institute of Metals will be held at noon on Wednesday, April 19th, in connection with the Twelfth Annual May Lecture. This Lecture is to be delivered on Wednesday, May 3rd, by Professor Sir Ernest Rutherford, F.R.S., of Cambridge University, on "The Relation of the Elements." Membership Application Forms and cards of invitation to the Lecture may be obtained on application to Mr. G. Shaw Scott, M.Sc., the Secretary of the Institute of Metals, 36, Victoria St., London, S.W.1.

THE OPTICAL SOCIETY.

The next meeting of the Optical Society will be held at the Imperial College of Science and Technology, South Kensington, at 7.30 p.m., on Thursday, 6th April, 1922, when the following papers will be presented and discussed:—

"Diffraction halos in normal and glaucomatous eyes," by H. H. Emsley, B.Sc., and E. F. Fincham.

"The effect of changes of curvature at the focus of an astronomical object glass," by E. Wilfred Taylor.

ROYAL MICROSCOPICAL SOCIETY.

A meeting of the Society will be held in the Lecture Hall, 20, Hanover Square, on Wednesday, 19th April, 1922, at 5.30 for 8 p.m., when the following papers will be read:—

Mr. Conrad Beck, C.B.E., F.R.M.S., "The Photometry of a Bull's-Eye Lens for Illuminating Microscopic Objects."

Dr. S. C. Harland, D.Sc., and Mr. J. H. Denham, M.A., F.R.M.S. (The British Cotton Industry Research Association). "The Use of the Microscope in Cotton Research."

Dr. R. S. Ludford, Ph.D., B.Sc., F.R.H.S., F.R.M.S., "The Morphology and Physiology of the Nucleolus."

Mr. Herbert Sutcliffe, A.R.C.Sc., F.L.S., F.R.M.S. (Rubber Growers' Association), "The Use of the Microscope in the Rubber Industry."

CHEMICAL NOTICES FROM FOREIGN SOURCES

DETERMINATION OF SULPHUR IN IRON PYRITES — *G. Chaudron and G. Juge-Boivard*.—Iron disulphide FeS_2 exists in two forms, cubic pyrites and marcassite or white pyrites, which crystallises in the rhombic system. Iron pyrites often contains considerable quantities of copper and zinc sulphide. The authors have studied its behaviour when subjected to the action of various liquids, such as concentrated nitric acid, and nitric acid containing three times its volume of concentrated hydrochloric acid, working at different temperatures. They have found that the action of aqua regia and concentrated nitric acid is always the same if pyrites is used. With marcassite at the ordinary temperature no sulphur separates, but at about 70° it is formed. Specimens of pyrites containing copper and zinc sulphides are very readily attacked by nitric acid and aqua regia. Sulphur is separated when the temperature exceeds 60° . If the reaction is carried out in the cold the sulphur is totally oxidised.—(*Comptes Rendus*, CLXXIV., No. 10, 1922).

REDUCTION OF ETHYL BENZOATE AND OTHER BENZENE DERIVATIVES BY SODIUM AND ABSOLUTE ALCOHOL—*Hervé de Pommerau*.—When a solution of ethyl benzoate in absolute alcohol reacts with sodium, a solid substance is first formed, but it redissolves

slowly on heating. After saponification hexahydrobenzoic acid and a small quantity of a tetrahydrobenzyl alcohol are formed. This latter $\text{C}_6\text{H}_9\text{CH}_2\text{OH}$ is a colourless liquid boiling at 188° under 760 mm. It fixes two atoms of bromine giving a urethane which can also fix two atoms of bromine in solution in carbon disulphide. The study of the reduction of benzene derivatives by means of alcohol and sodium (e.g., benzoic acid, benzyl alcohol, phenol, aniline, nitrobenzene, etc.), shows that only the radicals to which a carboxyl group is directly fixed are easily reduced.—(*Comptes Rendus*, CLXXIV., No. 10, 1922).

HYDROGENATION OF QUATERNARY SALTS OF HEXAMETHYLENE TETRAMINE—*Marcel Sommelet and Jean Guioth*.—Hexamethylene tetramine $(\text{CH}_2)_4\text{N}_4$ resembles the tertiary amines in its properties; for example, it unites with the halogen alcohol derivatives to give quaternary ammonium salts. It is easily hydrolysed by acids, and the quaternary salts show the same property. They are decomposed even by boiling water, giving among other products the aldehyde RCHO corresponding to the residue RCH_2 existing in the quaternary salt. When a mixture of formic acid and the chlorobenzylate of hexamethylene tetramine is slowly heated, carbon dioxide is evolved, and finally one of the principal products of the reaction is N-dimethylbenzylamine. Possibly the chlorobenzylate is transformed by hydrogenation, so that the chain $\text{C}_6\text{H}_5\text{CH}_2\text{-N} \begin{smallmatrix} \text{CH}_2 \\ \text{CH}_2 \end{smallmatrix}$ fixes two atoms of hydrogen, the rest of the molecule meanwhile giving ammonia and the methylamines. The authors have studied many quaternary salts of hexamethylene tetramine, in order to see if this new method of preparing a tertiary amine containing two methyl groups attached to a nitrogen atom is generally applicable, and have found that the reaction occurs in every case investigated, though the yields are sometimes poor. It appears that the method is practically useful only in the case of the quaternary salts containing a benzyl group.—(*Comptes Rendus*, CLXXIV., No. 10, 1922).

EXTRACTION OF TANNIN—*E. Knappe*.—The author has studied the use of certain substitutes for ether in the extraction of natural tannins. He used trichloro-ethylene mixed with alcohol in the proportion of three parts of the former to one of the lat-

ter. Decolouration was effected by shaking with calcined sodium sulphate, and clarification by sulphate of zinc and ferrocyanide of potassium, etc. The separation of the extract was performed by driving off the solvents over a water bath in vacuo and substituting water for them drop by drop. A mixture of the solvents containing 1/5th or 1/6 of water can also be used. If the liquid is shaken and then allowed to settle, two layers are obtained. One contains tannin and alcohol, while the lower contains nearly all the trichloro-ethylene and traces only of tannin. In this process only the upper layer has to be evaporated. Trichloro-ethylene and acetic acid give analogous results. These solvents have the advantage over ether of being cheaper and less volatile. — (*Chem. Zeit.* XLV., No. 30, 1921).

NOTES ON BOOKS.

Anthracene and Anthraquinone, by E. DE BARRY BARNETT B.Sc. (Lond.), Lecturer in Organic Chemistry at the Sir John Cass Technical Institute. Pp. xii. plus 436. London: Baillière, Tindall & Cox. Price 25/- net.

The monograph, under review, deals with the theoretical side of a very important section of the manufacture of artificial dyestuffs. Up to the year 1868 anthracene was regarded merely as a chemical curiosity, but in that year Graebe and Liebermann made the discovery that alizarin was derived from anthracene. This discovery furnished the clue to the synthesis of the important colouring matter used in the dyeing of "Turkey Red" and formerly obtained from the root of the madder plant. The manufacture of alizarin by the synthetic method was soon established, and as a result of the interest stimulated by this success an enormous amount of research has been carried out in this field, so that, to-day, in addition to the mordant dyestuffs, which are also built upon the anthraquinone nucleus, are commercial products.

The author deals with his subject in a systematic manner, and endeavours to co-ordinate the work of the many experimenters with considerable success. The hydrocarbon and its homologues and their simple derivatives are first described, then follows a description of anthraquinone and allied

compounds together with their simple derivatives; and finally compounds having a more complex structure, containing the anthraquinone ring system, are discussed.

It is unfortunate that more care was not taken over the proof reading and the faulty naming of several substances thereby avoided—for example, on page 129, 1.4.6. trihydroxybenzoic acid should read 1.4.6. trihydroxyanthraquinone. The use of such phrases as "by the action of dilute oleum" (p. 144) does not improve the book. It is doubtful whether the use of Paff's system of formulation can be justified, and though it may have some advantages when making notes or from the lecturer's standpoint, yet it is a shorthand system unsuited to works of such a permanent nature as a monograph.

However, the book will be very useful to those interested in this subject, and we should like to suggest that, in a future edition, the year be given when quoting references so that the reader may follow the development of the subject with greater ease, and further that the "Index to German Patents" be extended so as to include references to the English Patent literature and also to Friedländer's "Fort-schritte der Teerfarbenfabrikation."

F. L. S.

Applied Calculus, by F. F. P. BISACRE, O.B.E., M.A. (Cantab.), B.Sc. (Lond.), A.M.Inst.C.E. London: Blackie and Son, Ltd. 1921. Pp. xv. plus 446. Price 10/6 net.

Science students frequently find it difficult to acquire a sound working knowledge of the Calculus. In this text-book, written especially for science and engineering students, the author has presented his subject in a most attractive manner. Only a very elementary mathematical knowledge, including trigonometry up to the formulæ of sines, is assumed. A simple yet adequate introductory chapter prepares the student for the general principles which are presented and developed in an interesting way. Simple practical illustrations and apt quotations from such remote sources as the Old Testament and Shakespeare, as well as from the writings of mathematicians and philosophers, are introduced to maintain a keen interest in the subject.

When the student has worked through the examples in the sections on the various practical applications, he will be in a posi-

tion to use and understand the use of the Calculus for dealing with problems in Physics and Physical Chemistry. For instance, in the chapter on Problems in Chemical Dynamics, the author shows the way to determine whether a particular gas reaction is mono or bimolecular, etc. In further examples, data on the decomposition of arsine and of phosphine are supplied, and from these the student is given certain expressions to calculate, and draw his own conclusions. Some of the examples given and exercises set, are taken from original scientific communications, and the exercises at the end are selected from examination papers.

A distinctive feature of this book is the inclusion of portraits and stimulating biographical notes, not only of distinguished mathematicians, but also of physicists and physical chemists.

REVIEWS BY GERALD DRUCE.

ALCHEMY: ANCIENT AND MODERN.—

Being a brief account of the alchemistic doctrines, and their relations to mysticism on the one hand, and to recent discoveries in physical science on the other hand; together with some particulars regarding the lives and teachings of the most noted alchemists. By H. Stanley Redgrove, B.Sc., F.C.S. Pp. XX, plus 141 plus 16 plates. London: William Rider & Sons, Ltd., 8, Paternoster Row, E.C. 4, 1922. Price 7/6 net.

It is much to be regretted that chemists have devoted so little attention to the early history of their science, in connection with which so many questions of interest and importance arise. To this new and revised edition of Mr. Redgrove's book—almost the only work on this subject in English, and certainly the best with which we are acquainted in any language—we extend a very hearty welcome. Mr. Redgrove combines a comprehensive grasp of chemical theory with sympathy for the philosophical attitude of the alchemists, a combination essential to the present study, but unfortunately by no means common. He gives an adequate survey of alchemical theory and method, shows how it arose as a result of philosophising by a *priori* method, and exhibits its achievements and failures. The lives and teachings of the leading alchemists are sketched and very interesting

lives many of them are. The transformation of alchemy into chemistry is then depicted, and, finally, modern theories concerning the nature of the elements and the possibility of transmuting them are very satisfactorily dealt with. Mr. Redgrove exhibits special ability in bringing into relation with each other the old-time speculations and the latest achievements in chemical theory, showing on the one hand how it is now possible to regard the views of the alchemists with greater sympathy than was the case in the immediate past, and, on the other hand, in what sense it would be an exaggeration to describe these speculations as anticipatory of modern theory. We note that the section of the book dealing with "modern alchemy" has been brought thoroughly up-to-date. The theory of isotopy is admirably explained, and the work of Aston, Rutherford, Soddy and their co-researchers has been adequately dealt with. In the present edition we notice also several minor emendations and improvements. The attractiveness of the book is enhanced by the very fine lithographic reproductions of old portraits of alchemists and of engravings from old alchemical works with which it is illustrated. In a word, this is an admirable and indispensable book, and should be in the library of every serious student of chemistry.

J. G. D.

GENERAL NOTES.

BIRMINGHAM AND MIDLAND INSTITUTE.—

An illuminated address and a cheque were presented on Friday, March 24, to Mr. William Russell, F.I.C., on his retirement after 40 years' service as Teacher of Chemistry, first at the Birmingham and Midland Institute, and subsequently at the Municipal Technical School. Tribute was paid to the deep interest taken in the personal welfare of the students by Mr. Russell, to the great value and effectiveness of his teaching, and to the important influence his work had exercised on the training of men in the chemical industries of Birmingham and the Midlands. Dr. W. E. Sumpner presided, and the presentation was formally made by Mr. W. Waters Butler, an old student.

DYESTUFFS IMPORTATION.—In the House of Commons last week, Mr. Riley asked the President of the Board of Trade if he had received a communication from Thomas H. Daniels, of Belfast, complaining of the refusal of the Dyestuffs Advisory Committee to allow him to import alizarine cyanole violet R. and alizarine brilliant green S.E. powder, the latter of which he stated he could import for 16s. a lb., whereas he was referred to a British firm whose price was 30s. for the same colours but with half the strength; will he verify this complaint?

Sir Philip Lloyd-Greame, Secretary to the Overseas Trade Dept., said: "I have received a communication from the firm mentioned, who I understand are agent for a German dye-making company. Of the applications in question the first was refused by the Dyestuffs Advisory Licensing Committee on the ground that a satisfactory British equivalent for the dyestuff mentioned was available. The applicant then raised the question of the difference in price, and was informed that applications based on that ground could be entertained only when made by the actual consumer. As regards the second case, the question of price difference was not raised by the applicant, who in fact quoted in his application to the Committee the German price as 36s. a lb., and not 16s. as stated by the hon. member. I am not prepared to overrule the action of the Advisory Committee in this matter."

On March 15th, Mr. Remer was refused leave, by 197 votes to 115, to introduce a Bill to amend the Dyestuffs (Import Regulation) Act, 1920.

CRYSTALLISATION OF DIAMONDS.—In a note on the crystallisation of diamonds, Dr. R. J. Sutton, Director of the Kimberley Observatory, S. Africa, refers to the frequent inclusion of minerals in the form of either fragments or complete crystals, and suggests that these various inclusions will set up strain and that most diamonds found broken owe their rupture to this cause. Dr. Sutton discredits the accounts of the bursting of natural diamonds, and attributes such strain as is revealed in the polariscope entirely to inclusions. Reference is made to the statement by Sir William Crookes of the explosion of an artificial diamond of microscopic dimensions that had been produced under conditions of great pressure.

In this connexion the writer would like to state that he has in his possession a well formed crystal from the Newlands Mine, Kimberley, which shows in the polariscope evidences of very considerable strain and in which there is no appearance of inclusions such as are described by Dr. Sutton.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 6021 Attwater, R.—Method of manufacturing formaldehyde condensation products of phenols. March 1.
- 6086 Blumenfeld, J.—Production of titanite acid. March 1.
- 6183 British Dyestuffs Corporation, Ltd.—Separating alkylamines from ammonia, etc., gases. March 4.
- 6024 Byron, J. G.—Method of manufacturing formaldehyde condensation products of phenols. March 1.
- 6313 Holderoff, G. F.—Bleaching fats, fatty oils, and fatty acids. March 3.
- 6080 Morgan, J. S.—Separating oxygen from atmospheric air. March 1.

Specifications Published this Week.

- 175,384 White, A. E.—Recovery of gold from pyritic ores.
- 153,918 Merck, J.—Preparation of tropinone mono-carboxylic acid esters.
- 155,299 North, Dr. W.—Production of zirconium.

Abstract Published this Week.

Phenyl glycine compounds.—Patent No. 173,540. Messrs. H. Levenstein and G. Imbert, of Crumpsall Vale Chemical Works, Blackley, Manchester, have invented a new method of producing tetrachlorethane or trichlorethylene and aniline in aqueous suspension by heating with an alkali such as milk of lime to 140-190°C. until the conversion of the intermediate bodies such as ethylene-triphenyltri-amine into phenyl glycine compounds is complete. An autoclave provided with an agitator may be used. After 24 hours' heating, the excess of aniline may be distilled off and the residue cooled and filtered. The solid product may be converted into an alkali salt of phenylglycine, and the small quantity of the calcium salt remaining in the filtrate may be precipitated as the ferrous salt. In another method, ethylenetriphenyl tri-amine and a caustic alkali or alkaline earth are heated together. Specification 678 065,013/07, 5014/07, and 13176/07 are referred to. According to the provisional Specification, phenyl glycine anilide may be obtained as an intermediate product in the first method also, alkali, alkali hydrates, carbonates, silicates, aluminates, and zincates are suitable alkalies.

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Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on, post free, for the official price of 1s. each.

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The Editor would be obliged for any information as to the manufacture and supply of "Red Caustic Ash" that was produced in England before the war.

31-3-22.



POSTPONEMENT OF SALE.

THE SALE BY AUCTION, Advertised to take place at **HARTY FERRY FACTORY, FAVERSHAM, KINGSWORTH, and CLIFFE-AT-NOO, near ROCHESTER, KENT, on TUESDAY, APRIL 4th, and Following Days,**

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THE MINISTRY OF AGRICULTURE AND FISHERIES has for disposal, and invites tenders for the purchase of, the contents of an analytical and chemical laboratory, including reagents used in connection with research work at the Rats Research Laboratory, Mount Pleasant, London, E.C.1. There is also a quantity of factory apparatus used for the manufacture of rat bait.

A list of the articles for disposal will be supplied upon application to the Disposal Officer, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

Application for permission to inspect the apparatus should be made direct to the Research Chemist at the Laboratory. (Telephone: City 181).

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3235.

THE COAL INDUSTRY.

LESS UNEMPLOYMENT.

The tendency towards a steady reduction in the amount of unemployment in the coal-mining industry is being maintained. The total number of wage-earners on the colliery books at the fortnight ended Feb. 25 was 1,074,662, which represents an increase of 1 per cent. on the figures for a month previous. The percentage of unemployed among the insured workers of the industry on Feb. 21 is given by the *Labour Gazette* as 9.4, which is one of the lowest among the great producing and manufacturing industries of the country.

The average weekly number of days worked in the mines of Great Britain was 5.35 during the fortnight ended Feb. 25. This is an increase of 0.19 over a month ago and 0.71 over a year ago.

BRAZILIAN CENTENARY EXHIBITION.

UNIQUE OPPORTUNITY FOR BRITISH MANUFACTURERS.

To the Editor, "*Chemical News*."

Sir,—As members of a Committee which has raised £25,000 towards the cost of British participation in the forthcoming International Exhibition, to open at Rio de Janeiro on the 7th September next, we ask for the hospitality of your columns to emphasise the need for making the British Section truly representative of all that is best in British industries. We appeal to manufacturers and merchants who possess or hope to secure connection with Brazil and South America generally to regard this as an occasion of unique historic interest to Brazil, with whom during the last 100 years and more this country has maintained the most friendly relations alike in the sphere of politics and trade.

Every advantage will be taken of this opportunity by other nations whose competition is formidable in this market. The absence on an occasion of this kind of British firms whose names are household words in South America would, therefore, be as damaging to their interests as to the national reputation.

The site allotted for the British building is one of the best in the whole Exhibition, and we are informed from Brazil that the work in its construction is well in advance of that done by other nations. All that is necessary to ensure the complete success of the British Section is that British commercial and industrial firms should consider their own ultimate interests and those of this country by maintaining our position in the eyes of the Brazilian people and Government, our friends and allies, whose independence for one hundred years is about to be celebrated.

Any applications made to New Court, St. Swithin's Lane, E.C.4, will receive attention.—Yours truly,

LIONEL DE ROTHSCHILD.
BESSBOROUGH.
E. GORE BROWN.
ARTHUR COOK.
EDWARD GREENE.
W. DOURO HOARE.
FOLLETT HOLT.
C. E. JOHNSTON.
E. R. PEACOCK.
C. D. SIMMONS.
J. O. UNWIN.

POLYMERISATION AT THE CRITICAL TEMPERATURE.

By Wm. R. Fielding, M.A., M.Sc., Fict.,
Senior Science Master at King Edward VII.
School, Lytham.

[NOTE.—The data used in this paper have been taken from Landolt-Börnstein's Tables, and the paper is a continuation of "Polymerisation amongst Liquids," (*Chem. News*, 1921, Vol. 122, p. 289.)]

(Continued from Last Week).

Ethylene, C_2H_4 .

$$T_c = 283$$

$$P_c = 51$$

$$d_c = (1) 0.32$$

$$(2) 0.21$$

$$p_c = (1) 1.51 \text{ (if } d = 0.32)$$

$$(2) 2.27 \text{ (if } d = 0.21)$$

$$s_c \text{ (calc)} = 2.45$$

$$s_c \text{ (probable)} = 2.45$$

$$p$$

$$= 1.6^\circ \text{ (if } p = 1.51) \text{ Liquid}$$

$$= 1.08 \text{ (if } p = 2.27) \text{ Solid}$$

TABLE V.

	T	P	s	Sp. ht. of gas at T. sp. ht. of liquid at C.T.			
				(1)	(2)	(1)	(2)
Gas	30		0.450	0.249	0.374	1	1
	379	1	0.404	0.277	0.417	1.11	1.11
	51		0.484	0.3	0.448	1.20	1.19
Liquid	283	1	1.62	1		1	
		2	1.08		1		2.67

At 283° the specific heat in the gaseous state will be greater than at 379°; therefore the ratios, 1* and 2.67 will be less.

The results of Tables II.-V. are summarised in Tables VI. and VII.

TABLE VI.
Specific heat of gas at C.T.
sp. heat of liquid at C.T.

N ₂ O	0.97
CO ₂	0.92
C ₂ H ₄	(1) 0.30
	(2) 0.45
CH ₄	0.5

TABLE VII.
Spec. Lt. of gas at CT
" " " Liquid " Las ratio
Multiplied by the
number of atoms
(1) in molecule
(2) in polymer

C.T.	p	Spec. Lt. of gas at CT	" " " Liquid "	Las ratio	Multiplied by the number of atoms
N ₂ O	311	2.28	0.97	2.91	6.63
CO ₂	304	2.17	0.92	2.76	5.99
C ₂ H ₄	183	2.27	0.45	2.70	6.13
		1.51	0.30	1.80	2.72
CH ₄	191	1.90	0.5	2.50	4.75

For the three substances, N₂O, CO₂, C₂H₄, whose critical temperatures are close together, the products in the last column are not very dissimilar, except when p for ethylene is taken as 1.51. This value was based on d_c = 0.32 which seems, therefore, to be wrong. If d_c = 0.21 then p = 2.27.

TABLE VIII.

Subs t.	d _c	T _c	P	Formula	Wt.	p
H ₂ O		647	217.5			
C ₂ H ₅ OH	0.2755	516	63		46	1.94
(C ₂ O ₃) ₂ O	0.26	467	36		74	2.1
CH ₃ COOH	0.3506	594	57.1		60	1.57
H ₂ O		647	217.5			
CH ₃ OH	0.2722	513	78.5		32	1.71
C ₂ H ₅ OH	0.2755	516	63		46	1.94
C ₃ H ₇ OH	0.2734	537	50		60	1.945
H ₂ O		647	217.5			
CH ₃						
C ₂ H ₅ O	0.307	441	46.3		60	1.95
(C ₂ H ₅) ₂ O	0.26	467	36		74	2.1

This result may be put to another use. p_c for xenon was found to be 2.60 (at 288°).

The Vap. Wt. = 150

R = 1.15

s_g (calc) = 0.884

s_c (probable) = 0.884 = 0.338 (liquid)
2.6

∴ Sp. Ht. of Xenon (gas) at C.T. No. of atoms
" " " liquid " " X in molecule
= 2.70.

∴ Sp. heat of xenon (gas) at 288° and under a pressure of 57 atmos. is about 0.913.

Or, Sp. ht. of gas at C.T. No. of atoms
" " " liquid " " X in polymer
= 6.13

∴ Sp. heat of xenon (gas) at 288° and under a pressure of 57 atmos. is about 0.798.

NOTE.—At the C.T. (liquid state),

p_c W s_c = k

where p_c is degree of polymerisation.

W = average Wt. of atom.

s = sp. heat.

k = a constant depending on temp.

(See *Chem. News*, Vol. 122, p. 292)

In Table VIII. I have worked out a few results for a number of organic substances.

{	C_6H_6 ...	0.3045	561.5	47.9	78	2.08		
	$C_{66}H_5F$...	0.3541	559.6	44.57	96	2.06		
	C_6H_5Cl ..	0.3654	632	44.67	112.5	2.07		
	C_6H_5Br	0.4853	670	44.52	157	2.05		
{	CH_3CN	0.2371	548	47.7	41	1.43		
	$C_2H_5.CN$	0.2404	564	41.3	55	1.60		
				53.8		2.08		
	HCl	0.61	325	86	36.5	1.51	55.1	54.7
{	CH_3Cl ...	0.370	416	66	50.5	2.06		

The results given in Tables I. and VIII. agree only occasionally with those obtained from Guye's equation. In many cases they appear to be either the arithmetic or geometric mean between the values at the boiling-point (1 atmos.), and in the gaseous state (1 atmos.). Hydrogen is almost entirely H_2 at the C.T., whereas bromine is Br_3 , and the inert elements, argon, krypton, and xenon are polymerised to a surprising extent, consisting of perhaps,

A_2 and A_4 . The oxides, N_2O , CO_2 , SO_2 are almost equally polymerised ($2+$), whereas water is $(H_2O)_{1.34}$ to $(H_2O)_{1.5}$ according to the critical density we decide to accept. The monohydric alcohols are more polymerised than water, and p for methyl alcohol seems to be less than for other members of the series. The halogens derivatives of benzene have the same p as benzene itself.

(To be Continued.)

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, MARCH 30, 1922.—*Sir Charles Sherrington, President, in the Chair.*—The following papers were read, the summaries here printed having been supplied by the authors for use at the meeting:—

The late W. G. RIDEWOOD, D.Sc. Observations on the Skull in Fœtal Specimens of Whales of the Genera *Megaptera* and *Balenoptera*. Communicated by Prof. E. W. MacBride, F.R.S.

Five fœtal skulls are described—three of *Megaptera nodosa*, one of *Balenoptera borealis*, one of *B. musculus*. The presence of an interparietal bone in some whales, and the meeting of the parietals in a median suture in others, is discussed. The value of these characters in taxonomy is discounted.

Syncondyly is regarded as associated with suppression of the atlanto-epistropheal joint.

There is no separate foramen for the hypoglossal nerve.

The petiotic bone shows no separate centres of ossification, but a diffuse endochondral granular deposit. The orbitosphenoid ossifies independently of the presphenoid.

The confusion regarding pterygoid and alisphenoid bones is discussed, and is attributed to a spurious resemblance existing between the air-containing pterygoid fossa of whales and the pterygoid fossa of the ordinary mammalian skull.

In whales there is no "external pterygoid plate" of alisphenoidal origin; the alisphenoid is the ossified ala temporalis solely, with no additional plates of membrane bone. The author failed to confirm Schulte's observation of division of the pterygoid into external and internal.

The suggestion of homology between reptilian parasphenoid and mammalian vomer was made by Smets (1885), independently of Bland Sutton's remarks.

The growth of the malleus is described, and the homologies of the processes, regarded as still in doubt by Turner (1913), elucidated.

The growth of the tympanic bone, and the relations of the great bulla to the primary annulus tympanicus, are explained. The ingation of the tympanic membrane, claimed by Lillie (1916) as a discovery, is shown to have been recorded several times previously.

W. L. BALLS. Further Observations on Cell-Wall Structure as seen in Cotton Hairs. Communicated by Dr. F. F. Blackman, F.R.S.

The fully growth rings described in an earlier communication ("Proceedings," B. vol. 90, 1919), are shown each to consist of a large number of fibrils, which are spirally arranged, with frequent reversals of the direction of the spirals. It appears that this arrangement is predetermined for the secondary cellulose of the growth rings by the initial pattern laid down in the primary wall during the period of growth in length. The consequent radial super-position of the fibrils in successive growth rings appears to be a general phenomenon, whereof the formation of simple pits in the wall is merely a special case. The individual fibrils have a cross-sectional area of the order of 0.05 square microns, so that this analysis of the wall structure is approaching problems of molecular arrangement. Some of the evidence is suggestive of the existence of stereo-isomerism in cellulose.

L. T. HOGGEN and F. R. WINTON. The Pigmentary Effector System. I.—Reaction of Frog's Melanophores to Pituitary Extracts. Communicated by Prof. E. W. MacBride, F.R.S.

The posterior lobe of the pituitary gland contains a specific stimulant which, if injected into the frog, brings about a condition of general and complete expansion of the dermal melanophores: a dose equivalent to 0.0003–0.0005 cc. of commercial "infundibar" preparations (Borroughs and Wellcome) is sufficient to induce a darkening of the skin readily visible to the naked eye. The pituitary melanophore stimulant is not destroyed by pepsin or boiling: it is not identical with histamine, since neither histamine nor putrid meat extracts give this reaction. Furthermore, it is rapidly destroyed by trypsin. It is not rapidly destroyed by acid hydrolysis (continuous boiling with 0.5 per cent. HCl); and in this respect agrees with the oxytocic (uterine) and differs from the pressor principle. After cocaine, curare, atropine and apocodeine it still evokes its characteristic response, and therefore acts probably directly upon the melanophores themselves. The result of the experiments confirms the endocrine significance of the condition of general pigmental contraction found by Allen and others to follow removal of the pituitary gland in tadpoles. If Spaeth's observations are correct, the melanophores of amphibians and fishes respond in an opposite manner to the pituitary autacoid: the

action of the latter is also opposite to that of adrenin in the amphibia.

AGNES ARBER, D.Sc. On the Development and Morphology of the Leaves of Palms. Communicated by Prof. F. W. Oliver, F.R.S.

The developmental history and homologies of the members constituting the mature palm leaf have long been subjects of controversy. In this paper a renewed attempt is made to interpret the leaves of this group, on lines which have suggested themselves in the course of the writer's study of the leaves of other Monocotyledonous families. On the evidence of ontogeny and comparative morphology the following conclusions are reached:—

1. The leaf-stalk, which succeeds the basal sheath, is, both in fan- and feather-palms, the basal or proximal region of the true petiole.

2. The "fan" or "feather" limb is not, morphologically, a lamina, but a modification of the distal region of the true petiole. The complex plication of the limb arises through the development of a series of invaginations, which penetrate the leaf-stalk tissue between the bundles.

3. The "ligule" and "dorsal scale" of the fan-palms are not morphological entities, but merely represent adaxial and abaxial distal margins of the uninvaginated proximal region of the petiole. The terms "ventral crest" and "dorsal crest" are proposed as substitutes for the terms "ligule" and "dorsal scale."

4. The palm leaf, regarded as a whole, is on the present interpretation a petiolar phyllode with a pseudo-lamina—a conception which brings it into essential relation with the leaves of other Monocotyledons.

H. E. ROAF. The Acidity of Muscle during Maintained Contraction. Communicated by Sir Charles Sherrington, P.R.S.

Records of electrical changes by a manganese dioxide electrode in combination with a calomel electrode show that:—

1. In a veratrinised muscle the acidity remains as well as the tension.

2. In decerebrate rigidity reflex inhibition is accompanied by a decrease in acidity.

These results indicate that acidity and tension are related, and that a single mechanism is sufficient to account for both tetanus and tone.

THURSDAY, APRIL 6, 1922, AT 4.30 P.M.—
Papers read:—

F. E. SMITH, F.R.S. On an Electromagnetic Method for the Measurement of the Horizontal Intensity of the Earth's Magnetic Field.

G. I. TAYLOR, F.R.S. Stability of a Viscous Liquid contained between Two Rotating Cylinders.

PROF. T. H. HAVELOCK, F.R.S. Dispersion Formulae and the Polarisation of Scattered Light; with Application to Hydrogen.

G. R. GOLDSBROUGH, D.Sc. The Cause of Encke's Division in Saturn's Ring. Communicated by Prof. T. H. Havelock, F.R.S.

C. SPEARMAN. Correlation between Arrays in a Table of Correlations. Communicated by Prof. L. N. G. Filon, F.R.S.

DR. W. L. BALLS. Apparatus for Determining the Standard Deviation Mechanically.

IRON AND STEEL INSTITUTE.

At the Annual Meeting to be held on May 4 and 5, 1922, the following papers are expected to be read:—

C. R. AUSTIN: "Hydrogen Decarburisation of Carbon Steels, with notes on related phenomena."

N. T. BELAIEV: "The Inner Structure of the Pearlite Grain."

N. C. H. CARPENTER and Miss C. F. ELAM: "Effect of Oxidising Gases at Low Pressures on Heated Iron."

F. CLEMENTS: "British Siemens Furnace Practice."

E. W. EHN: "Influence of Dissolved Oxides on Carburising and Hardening Qualities of Steel."

A. F. HALLIMOND: "On delayed Crystallisation in the Carbon Steels: the Formation of Pearlite, Troostite and Martensite."

K. HONDA: "On the Constitutional Diagram of the Iron-Carbon System, based on recent investigations."

K. HONDA and T. KIKUTA: "On the Stepped A 1 Transformation in Carbon Steel during rapid cooling."

D. E. ROBERTS: "Notes on Blast Furnace Filling."

D. SELBY - BIGGE: "Recent Developments in Power Production."

A. WESTGREN and G. PHRAGMEN: "X-ray Studies on the Crystal Structure of Steel."

J. H. WHITELEY: "Formation of Globular Pearlite."

N. YAMADA: "On the Heat of Transformation of Austenite to Martensite, and of Martensite to Pearlite."

THE ROYAL INSTITUTION OF GREAT BRITAIN.

LECTURES AFTER EASTER, 1922.

Friday Evening Discourses addressed to members and their friends at 9 p.m.

April 28: Arthur Harden, D.Sc., F.R.S., Head of Biochemical Department, Lister Institute, "Vitamin Problems."

May 5: Michael Grabram, M.D., F.R.C.P., "Biological Studies in Madeira."

May 12: H. H. Dale, C.B.E. M.D., F.R.S., Head of Department of Biochemistry and Pharmacology under Medical Research Council, "The Search for Specific Remedies."

May 19: Sir William Bragg, K.B.E., D.Sc., F.R.S., M.R.I., Prof. of Physics, University of London, "The Structure of Organic Crystals."

May 26: W. E. Dalby, B.Sc., F.R.S., M.Inst.C.E., Prof. of Engineering, Imperial College of Science and Technology, "The Internal Combustion Engine: Its Influence and its Problems."

June 2: Hon. Maurice Baring, O.B.E., "Gilbert and Sullivan" (with musical illustrations).

June 9: Joseph Barcroft, C.B.E., F.R.S., Fellow of King's College and Reader in Physiology, University of Cambridge, "Physiological Effects at High Altitudes in Peru."

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

ORDINARY MEETING, 5 APRIL, 1922.—
Held at the Chemical Society's Rooms, Burlington House, Mr. P. A. Ellis Richards (President), in the chair.

Papers, of which the following are abstracts, were read:—

"The Constants of Indian Beeswax," by O. D. Roberts, F.I.C., and H. T. Islip, A.I.C.

The paper deals with the examination of a number of samples of Beeswaxes col-

ected in Bengal and Eastern Bengal and Assam under the supervision of District Officers.

The authors have shown that the contents of many of these samples differ very appreciably from those previously recorded for genuine samples of Indian Beeswax.

"Note on the Layer Oil of the 'Tope' (Gadus gadus), by A. Chaston Chapman, F.R.S., F.I.C.

The author has prepared and has examined the Layer Oil of the Tope, a fish belonging to the Shark family, and gives the Analytical Data which he has obtained.

"Note on the Examination of Foods for the Presence of Sulphites," by A. Chaston Chapman, F.R.S., F.I.C.

The Author points out that in the examination of food products for the presence of Sulphurous Acid or Sulphites by the method usually adopted, somewhat heavy indications may be obtained in the case of products to which no sulphite has been added. He finds that where such products have been flavoured with, or contain substances such as onions or mustard which yield on distillation organic sulphur-containing compounds, the sulphur in such compounds may be wholly or partly oxidised by the bromine water to sulphuric acid, and the analyst may in consequence be led wrongly to infer the presence of added sulphites. In such cases a differentiation between sulphurous acid and organic sulphur compounds may usually be made by substituting hydrogen peroxide for bromine or iodine in the distillation process.

"Demonstration of Artificial Daylight for Laboratory Purposes" (Sheringham System), by Sydney H. Groom, B.A.

The Exhibitor gave a demonstration to show how the attachment so adjusted the rays from an ordinary gas filled electric globe as to give a light by which Colours have the same value as when viewed by daylight, and suggested how indicators, unworkable by artificial light, might be operated with this corrected illuminant.

"Certain Tropical Oilseeds," by E. R. Bolton, F.I.C., and D. G. Hewer, B.Sc.

The authors describe the following nuts and seeds, with suggestions as to the uses of the fats and oils then contain. Analytical data are given in each case: *Platonia insignia*, *Andira binha*, *Buddleia* sp., species of *Parinari* seeds, *Theobroma grandifolia*, and *Theobroma bicolor*.

SOCIETY OF CHEMICAL INDUSTRY.

BIRMINGHAM AND MIDLAND.

A meeting of the Birmingham and Midland Section was held at the Birmingham University Buildings on March 30, Dr. H. W. Brownsdon presiding. The following were the elections for the ensuing year:—

Dr. Ed. B. Maxted, Chairman; Professor Gilbert T. Morgan, D.Sc., M.Sc., O.B.E. (Chemistry Dept., University of Birmingham), and Mr. F. R. O'Shaughnessy, who has been for 17 years hon. sec. and treasurer of the section, which he was largely responsible for establishing, Vice-Chairmen; and Mr. G. King, hon. sec. and treasurer. On the motion of Professor A. R. Ling (Brewing Dept., University of Birmingham), seconded by Prof. Morgan, a vote of thanks was passed to Mr. O'Shaughnessy for his long and excellent service. Dr. Brownsdon said he would reserve his tribute to a later date.

ACTION OF AMMONIA ON REDUCING SUGARS.

An interesting paper, on (a) "The Action of Ammonia and of Amino-Compounds on Reducing Sugars"; and (b) "The Action of Ammonia on Dextrose and Lævulose," was read before the members of the Birmingham and Midland Section of the Society of Chemical Industry on March 30, by Dr. Arthur R. Ling and Mr. Dinshaw Rattonji Nanji, of the Dept. of the Biochemistry of Fermentation.

Mr. Nanji pointed out that this investigation was originally undertaken to throw some light on the mechanism of the reactions which occur in the manufacture of so-called caramel by the ammonia process. When ammonia is brought in contact with dextrose (fused or in aqueous solution) either in the form of gas or aqueous solution, at a moderate temperature—say 350–400°—combination of the ammonia with the sugar takes place. If, now, the liquid be heated to a higher temperature, e.g., 1000°, a vigorous exothermic reaction ensues, and there are produced dark coloured substances. Similar reactions occur when certain amino-compounds are substituted for ammonia. The production of colour in malt by the kilning process is due to a combination between the amino acids and the reducing sugar produced during germination, and the subsequent decomposition of these compounds when the malt is raised to a higher temperature on the kiln. The present experiments refer to the first stage

of the reaction between dextrose and lævulose respectively, and ammonia and the nature of the resulting compounds. When an excess of ammonia acts on dextrose at a temperature of about 35° , an additive compound is formed, being the analogue of aldehyde-ammonia, namely, glucose-ammonia. The solution was tested for amino-compounds with negative results. The presence of the aldehyde hydrate will decide the course of the reaction between dextrose and ammonia in aqueous solution. The ammonia, it may be assumed, combines with the elimination of one molecule of water. When to a solution of dextrose containing 20 grams of that sugar in 100 cc. concentrated ammonia is added in quantity amounting to just above one molecular proportion, in relation to the dextrose, and the solution is heated at a temperature ranging from 35 - 60° , it is found that the specific rotatory power is that of the usual mixture of glucose in equilibrium. When the heating is continued, the rotation still falls the more rapidly as the temperature approaches the higher limit. As the reaction proceeds the aldehyde hydrate is removed from the solution as glucose ammonia, and the equilibrium thus disturbed is restored by the conversion of more of the glucose with the aldehyde hydrate. Thus in the presence of an excess of ammonia the reaction proceeds to the point of complete conversion of the dextrose into glucose-ammonia. The experiments showed, however, that this reaction is a reversible one, and that the glucose-ammonia in solution dissociates, a certain equilibrium being probably established at any one temperature between the glucose-ammonia and the sugar present, the sugar obtained from the glucose-ammonia is not the aldehyde form. Glucose-ammonia reacts as an aldehyde towards alkaline solutions of some of the heavy metals: thus a mirror of metallic copper is formed in the cold when a solution is added to Fehling's solution or to ammoniacal silver nitrate solution. It does not, however, give Schiff's reaction.

A more thorough examination of the sugar obtained by the action of ammonia on dextrose showed that besides aldose it also contained a ketose. It was found that ammonia reacts with lævulose solutions much more vigorously than with dextrose solutions at temperatures above those of the ordinary room. The reaction in the case of lævulose is accompanied by instantaneous darkening and decomposition. The

product obtained from lævulose decolourised permanganate just as that from dextrose. It was evident that by the action of ammonia on either dextrose or lævulose a mixture in equilibrium of aldoses and ketoses is obtained. Their experiments showed that by the action of ammonia on dextrose or lævulose respectively, no mannose is formed, whereas Lobry de Bruyn and Van Ekenstein invariably obtained a small quantity of that sugar which is readily identified by the insolubility of its phenyl hydrazone. The explanation of this was receiving their attention.

The authors summarise the position thus: (1) Dextrose unites with ammonia at a temperature of 35° to form an additive compound glucose-ammonia. This compound reduces alkaline copper and silver solutions with the formation of a metallic mirror. It exists in solution in a state of dissociation, for the specific rotatory power is the same as that of the sugar freed from ammonia.

(2) An aqueous solution of the sugar obtained from glucose-ammonia in the form of a syrup reduces potassium permanganate at the ordinary temperature. (3) The sugar consists of a mixture of aldose and ketose in equilibrium, the equilibrium being changed according to reaction of the solutions. In a solution in $N/4$ HCl, 100 per cent. of aldose is present.

(4) Lævulose, when treated with ammonia, is partially converted into aldose, and this unites with ammonia. Possibly when the rotatory power has fallen to its lowest limit, complete conversion into aldose has taken place. The solution behaves in every way similar to the product from dextrose.

(5) When the ammonia is removed from this product a mixture of aldoses and ketoses in equilibrium is obtained.

Professor Ling added that the work was being continued.

A MICRO-KJELDAHL METHOD OF ESTIMATING NITROGEN.

Professor A. R. Ling and Mr. W. J. Price (Brewing Dept., University of Birmingham), read an interesting paper before the members of the Birmingham and Midland Section of the Society of Chemical Industry, on March 30, on "A Micro-Kjeldahl Method of Estimating Nitrogen." Mr. Price explained that in conducting experimental investigations in biochemistry it is desirable to be acquainted with some re-

little method of estimating hydrogen which requires the minimal quantity of material for each determination. The Kjeldahl method in its most approved form is one of applied applicability, and, moreover, it is known to which classes of compound it can be applied. The fact, however, that nitrogen in some states of combination in which it exists in organic compounds, cannot be estimated by the Kjeldahl method, is one which must be borne in mind. Among the nitrogenous substances which the biochemist has to handle, the great majority are amino or imino compounds, the nitrogen content of which can be estimated accurately by the Kjeldahl method. Their object was, therefore, to determine if a modification of the Kjeldahl method could be devised, requiring quantities of substance for each estimation containing nitrogen from 1.0—0.1 mgrm. The purpose of which they required a micro-Kjeldahl method was for the estimation of nitrogen in substances containing but a trace of protein and much carbon, e.g., starch preparations and other carbohydrates. In order to come within the range in which they worked, it was necessary to take a weight of carbohydrate amounting to 0.3–0.5 gram. Several experiments were carried out, using a mixture of phosphoric acid, sulphuric acid, and copper sulphate as directed by Polin and Denis. This procedure had, however, ultimately to be abandoned, owing to the difficulty encountered by the attack on the glass tubes. They were unable to obtain any glass which would withstand the action of the acid mixture, even when the phosphoric acid was reduced to the lowest limit. In the next series of experiments the weighed portion of the substance was heated in a boiling tube of hard glass for about five minutes with about 8 cc. of concentrated sulphuric acid until it charred. The liquid was then cooled about 1 gram of potassium persulphate was added, and the heating continued until the liquid was colourless. After cooling, 40 per cent. sodium hydroxide solution was added carefully, till the liquid was faintly alkaline, and 5 cc. of the Nessler reagent. The liquid was then made up to 250 cc. and its tint compared with that of a standard solution of ammonium sulphate containing the equivalent of 1 mgrm. of nitrogen in 250 cc. The Kjeldahl solution prepared in this manner was intensely cloudy owing to the pre-

sence of electrolytes, and it was therefore impossible to compare its tint with that of the standard solution. In order to obviate this difficulty it is necessary to distil the solution. With regard to the use of persulphate, this undoubtedly expedites the reaction which by its use can be reduced to about 30 minutes. The method finally adapted was as follows: An accurately weighed portion of the substance containing 1—0.1 mgrm. of nitrogen is introduced into a hard glass boiling tube, together with 1 gram of dry potassium sulphate and 0.02 gram of anhydrous copper sulphate, 8 cc. of concentrated sulphuric acid is then added and two drops of 2.5 per cent. platinum tetrachloride solution. A small funnel is placed in the mouth of the tube, and the contents are boiled gently until the liquid is colourless. In the case of carbohydrates this occupies about one hour. The liquid is then allowed to cool, about 15 cc. of distilled water added, and the diluted liquid boiled to expel any sulphur dioxide. Attempts to deal with the liquid direct were unsuccessful, and we found it necessary to distil. When cold, the liquid is introduced into a 300 cc. distilling flask, fitted with a tap funnel and connected with a Liebig's condenser by the side tube. The further end of the condenser is fitted with an adaptor, the end of which dips into about 50 cc. of water contained in a graduated 250 cc. flask. A few pieces of freshly ignited porous porcelain, free from nitrogen, are added to the flask to prevent bumping, and a small strip of litmus paper. Forty per cent. hydroxide is added through the tap funnel until the contents of the flask are alkaline. Distillation is now commenced and continued until all the ammonia has passed over. It is necessary to distil about 100 cc. To the distillate 1.5 cc. of 40 per cent. sodium hydroxide is added, and then 5 cc. of the Nessler reagent, the contents of the flask being well shaken after the addition of the sodium hydroxide and of the Nessler reagent. The liquid is now made up to 250 cc. A stock solution of ammonium sulphate is prepared containing 4.716 grams of that salt and 200 cc. of N sulphuric acid

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(to inhibit the growth of micro-organisms) in one litre. This solution contains one mgrm. of nitrogen per cc. One cc. of this solution is added to about 150 cc of water in a 250 cc. graduated flask; to this is

added 1.5 cc. of 40 per cent. hydroxide solution and 5 cc. of the Nessler reagent, the liquid being well shaken and made up to 250 cc. After allowing 5 minutes in order that the colour may develop 10 cc. portions of each of the two solutions—the Kjeldahl and the standard—are introduced into two small flat-bottomed tubes of colourless glass. In order that the method may yield accurate results, the relation between the degree of colouration by the Nessler reagent and the concentration of nitrogen as ammonia in a given solution, must be established. The Nessler reagent was prepared on the Folin and Denis plan.

LONDON COUNTY COUNCIL.

SCHOLARSHIPS IN ART OR SCIENCE AND TECHNOLOGY, 1922

The Council will be prepared to award in 1922: (a) 25 Technology and Science Scholarships; (b) 23 Art and Artistic Crafts Scholarships.

(1) The scholarships will be tenable for two years at full-time day courses at institutions at which higher instruction in technology, science, art or artistic crafts is given, and may be extended for a third year. They will enable students who are engaged in trades or occupations, and have attended evening classes for at least two years, to give up their day-work and pursue a course of advanced instruction in Engineering, Building, Chemical Industries, Printing, Motor-body Building, Leather and Furnishing Trades, Artistic Crafts, etc. Of the 23 art scholarships, 13 will be offered in general art courses, and 10 will be reserved for persons employed in artistic crafts.

(2) In some cases a maintenance grant, assessed on the merits of each individual case, will be provided, but it will not exceed £160 a year. Scholars will be required to pay their own incidental expenses, including examination fees, modelling expenses, books, apparatus, etc.

(3) Candidates must be British subjects, and their parents (or guardians) must reside in the administrative County of London unless the candidate is over 21 years of age on 31st July, 1922, and is self-supporting, in which case he (or she) must be ordinarily resident in London. They must be not less than 18 years of age on 31st July, 1922, and must have made at least 200 hours' attendance at a polytechnic, technical institute, or school of art in the sessions 1920-21 and 1921-22. They must have made

at least 80 per cent. of possible attendances in the latter session, ending 31st July, 1922. Allowance will be made for interruption of studies due to illness.

(4) Candidates will be required to submit details of their educational career and attainments and specimens of their work. They will be interviewed, and, if necessary, will be required to undergo a qualifying examination.

Application forms may be obtained from the Education Officer (T.2a), Room No. 539, New County Hall, S.E.1, and must be returned *not later than 1st May, 1922*. Particulars of all scholarships offered by the Council appear in the L.C.C. Scholarships Handbook, which may be obtained from P. S. King & Son, Ltd., 2 and 4, Great Smith Street, Westminster, S.W.1, price 3d., or by post 4½d.

R. BLAIR.

Education Officer.

L.C.C. Education Officer's Department,
New County Hall, S.E.1.
January, 1922.

CHEMICAL NOTICES FROM FOREIGN SOURCES

THIRD INTERNATIONAL CONFERENCE OF CHEMISTS.—The Third International Conference of Chemists will take place at Lyons from June 27 to July 2. The President will be M. Grignard, the Director of the School of Industrial Chemistry, and the Vice-Presidents are MM. Fougere, Gillet, Morel and Sisley, while the Secretary is M. Bernard. The general programme as at present arranged is as follows:—

Tuesday, June 27, 9 p.m.—Reception of the Delegates by the Municipality at the Hotel de Ville.

Wednesday, June 28, 9.30 p.m.—Meeting of the Council of the International Union.

10.30 a.m.—General Meeting of Delegates.

2.30 p.m.—Meetings of Committees.

5 p.m.—Tea for the Delegates, given by the President of the International Union.

Thursday, June 29, 9.30 a.m.—Meetings of Committees.

2.30 p.m.—Visits to Factories.

Friday, June 30, 9.30 a.m.—Meetings of Committees.

2.30 p.m.—Visits to Factories.

Saturday, July 1, 9.30 a.m.—Meeting of the Council of the International Union.

2.30 p.m.—General Assembly of the Delegates.

7.30 p.m.—Closing Banquet, given to the Delegates by the Lyons Chamber of Commerce.

Sunday, July 2.—Descent of the Rhone by boat.

Besides the meetings reserved for the representatives of the National Councils of the countries belonging to the International Union of Pure and Applied Chemistry, the general programme includes two important lectures, specially organised for the Lyons technologists. These lectures will be given by MM. Louis Lumière and Jean Perrin. Many firms have agreed to allow the delegates to visit them, and the final excursion will take the delegates to the neighbourhood of Marseilles, while they will be invited to take part in the second Congress of Industrial Chemistry.

SECOND CONGRESS OF INDUSTRIAL CHEMISTRY. The second Congress of Industrial Chemistry, organised by the Society of Industrial Chemistry, will take place this year at Marseilles, in the Technical Institute, from July 2 to 7. The President of the General Committee of Organisation and Administration will be M. A. Gardair, and the Vice-President M. A. Gouin, and there will also be a scientific and technical committee, of which the President will be M. Rivals. Among the questions to be specially discussed will be those dealing with the mineral, vegetable, and animal resources of the French colonies.

The general programme includes the following items:—

July 2, 9 p.m.—Reception of the members of the Congress by the Marseilles Committees.

July 3, morning.—Formal opening of the Congress; Lecture; Visit to the Technical Institute.

Evening.—Meeting of the Sections; Lecture.

July 4, morning.—Meeting of the Sections.

Evening.—Visit to the Colonial Exhibition; Technical Discussions in the various Pavilions; Dinner at the Exhibition; Evening Party.

July 5, morning.—Meeting of the Sections.

Evening.—Meeting of the Presidents and Secretaries; General Report; Formal closing Meeting; Lecture; Banquet.

July 6 & 7.—Visit to the works of the port of Marseilles, and factories.

The committee has arranged to issue a series of coupons, which will cover all the expenses at the hotels and restaurants and the banquets and excursions. Those who intend to take part in the Congress are asked to intimate their intention to do so as soon as the definite programme of the Congress is published. The Congress will be divided into groups as before, the Marseilles Technical Institute having placed at the disposal of the Organising Committee a large number of rooms and amphitheatres. Any technologist who has carried out any important researches in the course of the year is invited to make his results known at the Marseilles Congress, and thus to show his interest in this important event in the chemical world.

GENERAL NOTES.

FINE CHEMICALS.

In the House of Commons on Monday, April 3, Dr. Murray asked the President of the Board of Trade whether he was aware that, after exhaustive hearings before the Referee under Part I. of the Safeguarding of Industries Act, it was admitted by his Department, manufacturers, merchants, and scientists, that the term in the schedule, "fine chemicals," could not be interpreted; and if so, what steps he proposed to take to rectify the matter, or whether he proposed to continue the endeavour to enforce the Act?

Mr. Baldwin said that he was unable to accept the proposition laid down in the first parts of the question. The doubts which had arisen related only to a limited number of cases, which were of a borderline character, and provision for dealing with these was made in the Act itself. No further action appeared necessary.

ACETONE.

Major M. Wood asked the President of the Board of Trade if he was aware that acetone for industrial purposes was manufactured by two distinct processes, namely, from acetate of lime and by fermentation process; that both materials were identical; that they tested on analysis exactly the same, and that it was impossible to tell one

from the other; that the former was not liable on importation to duty under Part I. of the Safeguarding of Industries Act, and that the latter was liable; and whether he could state how the liability to duty of such material, when imported, was determined?

Mr. Baldwin said that he was aware that acetone, as sold, might be made by either of the two processes mentioned. The practicability of determinative tests of origin was under consideration, but should these be shown to be non-existent, the liability or non-liability of imported acetone to duty must be determined by such declaration by the importer as the Customs might deem sufficient.

SMUGGLED DRUGS.

Mr. Shortt, the Home Secretary, in answer to Mr. Morris, said that information was received from time to time that opium, cocaine, and other drugs were smuggled into the country, and it was known that Chinese seamen and others were addicted to the opium habit, but the police were not aware of any organised traffic. Every effort was made to detect offenders, but short of opening all incoming passengers' luggage, the minute search of every passenger, and the examination of every postal package, he was afraid that it would not be possible to suppress entirely the illicit introduction of drugs into this country as long as it was possible to obtain them without difficulty in other countries. The matter was one in which international co-operation was essential, and the whole question was engaging the attention of the League of Nations, which had been entrusted by the Treaties of Peace with the general suspension of the traffic in opium and other dangerous drugs.

THE EVOLUTION OF CHEMICAL TERMINOLOGY.—I. COAGULATION.

By JAMES F. COUCH.

(Reprinted from the "American Journal of Pharmacy," February, 1922).

In attempting to define with exactness many of the terms in common use at the present time it is often found that there is considerable latitude of meaning covered by the word or phrase. In many cases the limits set about the proper application of a term are vague and may permit its usage

in contradictory senses. Such indefiniteness, foreign to the modern scientific spirit, leads often to indiscriminate use of the term and clutters up the literature with much that is sloppy and too much that is not only misleading but positively erroneous. Unfortunately a great deal of this vagueness cannot be remedied as yet, for it proceeds from an insufficient knowledge of the phenomena with which the term is associated or results from the applying of the term to a broad field which contains within itself confusing and contradictory elements.

In other cases it happens that a term still in common use was applied generations ago to some type of phenomena which were imperfectly understood. With this as a foundation newly discovered facts were classified by more or less empirical methods according to analogy until the term is now made to represent things which in principle are widely different. Again, because of a lack of knowledge of the mechanism of natural processes, two facts which depend essentially on the same fundamental generality have been classified under different names because of some superficial difference in nature.

Another and a fruitful cause of confusion has been the use of specific terms in literature where the exigencies of rhetoric, of the avoidance of repetition, and the difficulties of conveying ideas, not to mention the foot-rule of versification, outweigh considerations of narrow exactitude in the choice of words. We read, for instance, that a large population was coagulated in London; we might, with equal propriety, refer to-day to the "gelated traffic" at our busy street crossings.

It is possible, however, to remedy a large part of the existing indefiniteness in the use of chemical terms; indeed, it is a simple matter. It requires only an agreement among those who employ the terms to limit certain expressions to certain specific meanings. With this very desirable end in view I purpose to consider in this, and in other communications which are in course of preparation, a number of loosely defined terms, to discuss the manner in which they are now used, to present any objections to this usage, and finally to propose whatever action appears to me best to eliminate the undesirable features.

What is coagulation? In referring to such authorities as the writers of text

books, particularly those that deal with physiological and colloid chemistry, we find that while frequent mention of the process of coagulation is made, and while it is often exhaustively discussed, the authors studiously avoid defining the term. One must dissect and analyze the whole matter presented by the author before his idea of the process may be determined. We turn, then, to the standard dictionaries of our language.

Webster's presents this definition: "Coagulate . . . To exert the coagulation of; curdle; clot; congeal; . . ."

James A. H. Murray defines "coagulate" thus: "1. To convert (certain fluids, as blood, milk, albumen, etc.), into a soft solid mass, as by chemical action, heat, exposure to air, etc.; to curdle, clot, congeal. 2. To form (anything plastic) into a solidified cake or mass; to form as a mass."

Funk and Wagnall's says: "Coagulate . . . To change (a liquid, as blood or milk) into a clot or a jelly, as by heat, by chemical action, or by a ferment; curdle; congeal."

The Century defines "coagulate" as follows: "To curdle; congeal; clot; change from a fluid into a curd like or thickened mass."

Gould defines "coagulation" as "The formation of a coagulum or clot," and Derland as "1. The process of changing into a clot or of being changed into a clot. 2. A clot."

W. Ostwald offers this: "Unter Koagulationsvorgängen disperser, im speziellen Systeme verstehen wir weitgehende Verringerungen des Dispersitätsgrades der dispersen Phase, verbunden mit einem Aufgeben der Homogenität der räumlichen Verteilung."

The generally accepted idea of the term coagulation, then, is this: It is a process which results in the separation from a liquid system of a non-rigid solid mass or the confersion of a liquid into such a mass. This definition is faulty in that it is too inclusive; it must be modified to distinguish between coagulation and such processes as flocculation, gelation, precipitation, congelation.

In the first place coagulation is a colloidal phenomenon. Albumen solutions, blood, milk, the latex of *Ficus elastica*, are all colloidal systems. By limiting coagulation to colloids we remove from consideration many similar phenomena which may,

under appropriate conditions, occur in true solutions. The precipitation of aluminium hydroxide by ammonia may give rise to a semi-solid mass which superficially resembles a coagulum. A characteristic of coagulation which readily distinguishes it from the process of gelation is that it involves a separation of the disperse from the continuous phase of the colloidal solution: in gelation there is no such complete and sharp separation, although it is true that the gel may lose its sorbed solvent by evaporation, in the course of time.

When we consider the question of the reversibility of coagulation processes, however, we discover no general agreement. While the common instances of coagulation (in albumen solutions, blood-clotting, etc.) are clearly irreversible, there is a large number of instances which are, by some authors, included in the general class of coagulations and which are known to be reversible. Bechhold considers coagulation as irreversible, but prefers to use the term "flocculation" for most colloidal separations. Analysis of his discussion of these phenomena leads to the following conclusion: Flocculation is an electrical phenomenon; it is irreversible; it consists in the precipitation of hydrophobe colloids by electrolytes. The system, therefore, cannot be flocculated unless it contains an hydrophobe colloid. He distinguishes reversible separations of dispersed phases and their continuous phases by the term "salting out." Bancroft, on the contrary, uses the term coagulation in the broader sense; e.g., he says (p. 221), "When albumin is precipitated by sodium chloride, the coagulation is ordinarily reversible. When it is precipitated by the salt of a heavy metal, the coagulation is irreversible." Consequently there is no agreement as to the reversibility of coagulation; each author determines this question by the extensiveness of his application of the term.

"Colloids in Biology and Medicine" Trans. J. G. M. Bullowa, 1919, p. 82.

"Applied Colloid Chemistry," 1921, p. 212, et seq.

Without attempting to analyse the whole mass of accumulated data it may be said that there are three general methods by which the separation of the phases in a colloidal system may be effected: 1. By alteration of the chemical nature of the disperse phase; 2, by altering the physical struc-

ture of the disperse phase; and 3, by altering the electrical equilibrium of the system or of the disperse phase. These are three very distinct processes and depend upon widely different mechanisms. Almost the only similarity is to be found in the end result and even here great differences occur. We know that in the heat-coagulation of albumins there is definite chemical alteration of the molecule; in the clotting process of blood a new substance, fibrin, which is not a factor of the initial system appears, formed from one of the constituents of the normal blood. Neither of these processes is reversible. In the curdling of milk, however, which is the third common instance of coagulation, the case is different. In the souring of milk or following the addition of rennin, the casein separates from the liquid mixture. Note that the curdling which follows souring—or the increase of hydrogen in concentration—is a true precipitation of salicyclic acid from an aqueous solution of sodium salicylate upon the addition of a stronger acid. It is not true coagulation. The action of rennin, on the contrary, produces curdling by altering the casein, and the process is not reversible. Consequently, in all three cases of coagulation which are common phenomena and from which our ideas of coagulation are primarily drawn, we have instances of irreversible changes.

Coagulation may be readily distinguished from congelation, as the latter term includes any solidification without regard to its nature or mechanism by which it is produced. The "setting" of wet plaster of Paris or of concrete mixtures are congelations. In the term precipitate we have a general name which includes all instances in which a solid or semi-solid substance, either in an integral mass or in a finely divided state, separates from a liquid. Coagulation is therefore a special case of precipitation. Flocculation may be considered a process in which the degree of dispersity of a colloid in suspension is diminished although this term itself is not narrowly defined and has been used in different senses.

Enough evidence has now been presented, I think, to show the necessity for the adoption of a convention in order to define these terms satisfactorily. We are forced arbitrarily to exclude certain ideas now associated with the terms and to restrict the assigned meanings to limits which will

sharply distinguish the different terms. It is therefore recommended that coagulation be defined:

An irreversible process of colloid chemistry; it consists of the complete or partial separation of the disperse from the continuous phase as the result of the chemical alteration of the system. The altered disperse phase is precipitated as a non-rigid, insoluble, solid mass, and that flocculation be considered:

A process of colloid chemistry in which the complete or partial separation of the phases is effected through an alteration of the physical condition of the disperse phase, either by a diminishing of its degree of dispersion or by a modifying of the electrical equilibrium of the system. The analysis suggests the usefulness of two new terms; collyte, a name for any disperse phase, and collysis, a general term to indicate any separation of the two (or more) phases in a colloidal solution.

New International Dictionary of the English Language, 1919, p. 424.

In some dictionaries the definition is given under the word "coagulation," in others it is given under "coagulate," and the derivative terms are referred to the form defined. I shall here make no distinction in quoting the lexicographers.

A New English Dictionary on Historical Principles, 1898, Vol. 2, p. 548.

New Standard Dictionary of the English Language, 1913, p. 508.

The Century Dictionary and Cyclopedia, Vol. 2, p. 1967, 1911.

An Illustrated Dictionary of Medicine, Biology and Allied Sciences, p. 305.

The American Illustrated Medical Dictionary, 1916, p. 230.

Grundriss der Kolloidchemie, 1910, p. 446. This definition may be freely translated: "By the process of coagulation of substances dispersed in colloidal systems we understand a far-reaching diminution of the degree of dispersity of the disperse phase accompanied by a giving up of the homogeneity of spatial distribution."

BOOKS RECEIVED.

The Vitamins, by Professor H. C. SHEEMAN & S. L. SMITH. Pages: III. + 273. The Chemical Catalog Company, 1, Madison Avenue, New York, 1922. Price \$4.

Zirconium and its Compounds, by FRANK P. VENABLE. Pages: X. + 173. The Chemical Catalog Co., Inc., 1, Madison Avenue, New York, U.S.A., 1922.

Inorganic Chemistry, by L. MARTIN LOWRY, C.B.E., M.A., D.Sc., F.R.S., Professor of Physical Chemistry in the University of Cambridge. Pages: X. + 943. Messrs. MacMillan & Co., Ltd., St. Martin's Street, W.C., 1922. Price 28/- net.

Powder Alcohol, its production and utilization, by G. W. MONIER-WILLIAMS, C.B.E., M.C., M.A. Pages: XII. + 323. Messrs. Henry Frowde and Hodder & Stroughton, The Lancet Building, 1 & 2, Bedford Street, Strand, W.C.2. Price 21/-.

A CONCISE HISTORY OF CHEMISTRY.—By T. P. HILDITCH, D.Sc. (Lond.), F.I.C. 1p. xii, plus 276. London: Methuen & Co., Ltd., 1922. Price 6/-.

The author has briefly and succinctly outlined the historical development of Chemistry. Introductory and early chapters deal with the general evolution of the science from the earliest times until distinct divisions appeared. The method has then been to treat each branch separately. Thus the history of Organic Chemistry is considered quite apart from the development of Inorganic Chemistry, and the same applies to Plant and Animal Chemistry and to the development of Physical Chemistry.

The chapters on Organic Chemical development have been described particularly well. Theories which have stimulated investigations or which are believed to assist in arriving at the ultimate truth are briefly but carefully considered.

The progress of experimental method is given too concisely. The short final chapter of the book not only covers the developments and improvements in apparatus and methods, but also includes the only references to chemical analysis and the determination of Atomic Weights. These important aspects of the Science thus receive inadequate treatment.

In the next edition the author could also advantageously alter his spelling of Mendeléeff's name.

There are two useful appendices. One is biographical, and catalogues the great achievements of important personalities. The other is a chronological summary of events of outstanding importance.

All who study chemistry should be acquainted with its development. This book, now in its second edition, therefore meets a real need, and should be widely read by all students.

J. G. D.

A COMPREHENSIVE TREATISE ON INORGANIC AND THEORETICAL CHEMISTRY.—By J. W. MELLOR, D.Sc. Vol. ii., pp. VIII, plus 894. London: Longmans, Green & Co., 1922. Price £3 3s.

In this volume the Author has attempted a compilation of all the compounds of the Halogen elements and of the Alkali metals known in Inorganic Chemistry.

He describes their preparation and properties, and wherever possible discusses them in the light of Physical Chemistry.

The collection and arrangement of the material incorporated in this volume must have involved much time, energy and patience. This applies particularly to the copious references to original papers quoted at the end of each paragraph. An idea of the extent of these will be perhaps realised when we state that at the end of the section dealing with the properties of the Alkali Chlorides, no less than six pages are devoted to references on this subject alone; each page contains about a hundred references. We should mention that those we have turned up have been verified.

The test appears to be an amplification of the Author's "Modern Inorganic Chemistry."

The Author might have figured a better apparatus for the preparation of Chlorine than that shown on page 26. Also in the pages on specific gravity and concentration of solutions there is no mention of Mendeléeff's extensive investigations on this subject.

The value of such a treatise as this is considerable, particularly since, in the past, reliance has largely been placed in Continental compilations. But, since there is no reference to atomic weight determinations, this volume does not quite cover the same ground as, say, Abegg's *Handbuch der Anorganische Chemie*.

The volume will undoubtedly find a place in all Chemical Libraries worthy of their name.

J. G. D.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

ABSTRACT OF PAPER READ BY MR. R. BORLASE MATTHEWS BEFORE, ON THURSDAY, 30 MARCH, 1922, AT 6 P.M.

Ancient Craft and Modern Knowledge.

Relatively to the great productive enterprises of which we hear so much, Agriculture may be called the Silent Industry, in spite of its importance and the rapidity with which variations in its fortunes react upon everyone's pocket, we hear but little of the farmer and his work, yet an engineer, who has gone back to the land with the analytical faculty of his profession has been telling the I.E.E. that the cultivation of the soil and the animals useful to man is still the greatest of human activities.

In England and Wales alone, states Mr. Borlase Matthews, there are 418,000 farms and small holdings, five-sixths of these are of less than 150 acres in extent.

The problem of increasing the yield of all these undertakings is of the utmost importance to the welfare and safety of the country. According to the experience of this expert is it possible even in our own climate, to raise much more food, reduce waste and failure and stabilise the conditions of the Agriculturist by the use of electricity on the farm.

Great progress in this direction has been made in America and Canada, and upon the Continent, whilst in our own country there are already some notable developments, as in the district of Hereford and certain parts of Wales.

The farm, and particularly the small farm, is not an ideal situation for machinery needing skilled attention; it is usually also impossible to supply it with gas, and costly to provide coal or heavy fuel. Electricity, which can at once be used to give light, heat, or drive machines, is obviously the simple and flexible form of power service needed on the land being so easily conveyed by overhead wires, without disturbance of the surface, and free to leave the line of the roads for any point where its services are needed.

Mr. Borlase Matthews has recently placed a record of his experience at the disposal of farmers in this country and on certain parts of the Continent, and has now brought the whole subject to the notice of the Institution of Electrical Engineers,

to a great extent depend for the general in- upon the energies of which body one must trodution of an Electric Power supply into rural areas.

The speaker has put forward some most interesting information upon the cost of using Electricity for all general operations around the farm buildings, the saving to be effected by employing electric light in cow sheds, the improvement in cleanliness, reduction in waste of milk, cattle food, and other materials by removing the dark and difficult conditions which exist during a large portion of the year in these buildings.

He shows also how readily an electric motor can be applied to driving different machines, for chopping cattle food, operating churns, milk separators, etc. These motors are entirely covered in from dirt and moisture, need no skilled attention, and can be moved about from place to place according to the work in hand, season of the year, etc.

More extensive applications of this form of power are applied to the ploughing of the land, whilst in other directions we find, as so often happens with the employment of electricity, that the incidental savings and economies resulting from it far outweigh any question of cost—for instance, it has already become the practice to dry hay artificially by means of electrically-driven fans—this gives the farmer much greater control over his crops, and makes him more independent of the weather.

In other districts there are records of the use of electric heating for the prevention of frost amongst stores of roots and vegetables, whilst already it is employed extensively for the drying of fruits in bottling factories and similar undertakings.

It will probably be news to many people to hear that the milking of cows by machinery, and machinery operated electrically, is coming into very general use, many farms employ now this method.

It is stated that in New Zealand over 9,000 farms are fitted with this valuable apparatus, which requires very little power, reduces the number of persons in charge, and goes a long way to provide the necessary cleanliness in handling milk.

(To be Continued.)



New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications

- 7370—Conso-tium für Elekt-chemische Industrie Ges. Manufacture of electrolytic chlorides. March 13.
 7373—Gardner, J. A. Production of artificial dyes. March 13.
 7378—Hellerbauer, A. Manufacture of chromate and bichromates. March 13.
 7392—Watson, J. K. Production of ammonium chloride. March 13.

Specifications Published this Week.

- 169,151—Soc. Franco Belge De Four's A. Coke (Soc. Anon.) Process for the treatment of gases from gas-producers.
 176,034—British Cellulose and Chemical Manufacturing Co., and Richardson, L. G. Treatment of cellulose acetate products.
 176,038—Lima, O. Y. Manufacture of new therapeutically active acridine derivatives.
 176,077—Hans, G. S. Manufacture of derivatives of 3:3-diamino-4 dioxarsenobenzene.
 176,144—Casale, Dr. L., and Leprestre, R. Apparatus for the catalytic synthesis of ammonia.

Abstract Published this Week.

Lead Sulphate; zinc oxide; furnaces.—Patent No. 174,555.—Messrs. H. Mayers & Britons, Ltd., of 17, Beauforte Road, Plaistow, and The Stowage Department, both in London, have been granted a Patent for a new treatment of minerals.

The production of distillates from mineral matters, such as the production of basic lead sulphate or zinc oxide from sulphide ores by feeding the ore on to a bed of fuel and oxidizing the vapour, the product being passed to cooling and filtering chambers, is effected in apparatus in which the draught through the filters and cooling-chambers and the air admitted to the furnace are controlled by means situated at the furnace itself, so that an operator, while watching the flame of the furnace, if necessary, through a spectroscope, can adjust the conditions so as to keep the oxidation constant.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3236.

THE PASTEUR CENTENARY.

STRASBOURG, MAY—OCTOBER, 1923.

In order to commemorate the Centenary of the birth of Pasteur, the University and the town of Strasbourg, with the concurrence of the Pasteur Institute, and the approval of the family of Pasteur, have proposed to erect a statue facing the Strasbourg University where, as a professor, Pasteur commenced his career.

The inauguration ceremonies will take place on May 1st, 1923, under the patronage of M. A. Millerand (President of the Republic), M. le Président A. Loubet, M. R. Poincaré, M. Loredu and M. Alapetite, and will include the unveiling of the statue and the opening of an exhibition of Hygiene and Bacteriology. This Exhibition will be designed to illustrate the advances made in various branches of science as the result of Pasteur's discoveries, and at the same time, a Congress of Hygiene and Bacteriology will be held for the discussion of questions relating to the prevention of disease.

With the object of showing the sympathy of this country with the projects of the French Committee, a British Committee composed of the following members has been formed:—

Sir Charles Sherrington, G.B.E., President of the Royal Society (Chairman).

Mr. A. Chaston Chapman, F.R.S., President of the Institute of Chemistry of Great Britain and Ireland (Treasurer).

Mr. H. E. Field, President of the Institute of Brewing.

Prof. Percy F. Frankland, C.B.E., F.R.S., Emeritus Professor of Chemistry, University of Birmingham.

Sir John M'Fadyoan, M.R.C.V.S., LL.D., Principal of the Royal Veterinary College.

Prof. C. J. Martin, C.M.G., F.R.S., Director of the Lister Institute.

Sir W. J. Pope, K.B.E., F.R.S., Professor of Chemistry, University of Cambridge.

Sir James Walker, F.R.S., President of the Chemical Society.

Sir Almroth Wright, K.B.E., F.R.S.,

Principal of the Institute of Pathology and Research, St. Mary's Hospital.

It is hoped that those who desire to contribute to the Memorial will send their contributions to the General Secretary and Treasurer, Monsieur Th. Héring, 6, rue des Veaux, Strasbourg, or to Mr. A. Chaston Chapman, F.R.S., The Institute of Chemistry, 30, Russell Square, London, W.C.1.

The Commissioner-General, Professor Borrel, is very anxious to be furnished with the names of manufacturers and business firms in this country to whom the Exhibition might be of especial interest. All who can assist are requested to communicate with Professor Borrel, 3, rue Koeberle, Strasbourg.

POLYMERISATION AT THE CRITICAL TEMPERATURE.

By Wm. R. Fielding, M.A., M.Sc., *Vict.*,
Senior Science Master at King Edward VII.
School, Lytham.

[NOTE.—The data used in this paper have been taken from Landolt-Börnstein's Tables, and the paper is a continuation of "Polymerisation amongst Liquids," *Chem. News*, 1921, Vol. 122, p. 289.]

(Continued from Last Week).

The following methyl compounds are arranged in order of p :—

	C.T.	p
CH_3CN	548 ...	1.43
CH_3COOH	594 ...	1.57
CH_3OH	513 ...	1.71
CH_3H	191 ...	1.90
CH_3Cl	416 ...	2.06

Van der Waal's equation takes no cognisance of polymerisation.

$$\text{From } \left(p + \frac{a}{v^2} \right) (v - b) = R.T.$$

$$V_0 = 3b.$$

That this is not so is clear from the following examples:—

	v_0	$3b$
N_2O	0.00436	0.005520
CO_2	0.00438	0.005721

For the values of p that I have obtained

$$v_0 \times \sqrt[3]{p} = 3b.$$

appears to be more nearly correct.

	v	p	$v\sqrt[3]{p}$	3b
N ₂ O (1894)	0.00436	2.28	0.005738	0.005520
CO ₂ (1907)	0.00438	2.17	0.00567	0.005721
(C ₂ H ₅) ₂ O (1908)	0.01292	2.1	0.01655	0.016749
C ₆ H ₆	0.01146 (1908)	2.08	0.01463	0.015450 (1893)
		1.94	0.008892	0.016107 (1910)
C ₂ H ₅ OH (1886)	0.00713			0.011307

If $v\sqrt[3]{p} = 3b$,

Then $v = \frac{3b}{\sqrt[3]{p}}$ and $\sqrt[3]{p} = \frac{3b}{v}$

and the critical volume or p can be found.

For example, p for H₂O is

$$1.34 \text{ (if } d_c = 0.429)$$

$$1.75 \text{ (if } d_c = 0.329)$$

$$b \times 10^6 = 1362 \text{ (Holborn u. Bauman, 1910)}$$

$$\therefore v = 0.004086 \text{ or } 0.004086$$

$$= \frac{\sqrt[3]{1.34}}{0.003706} \text{ or } \frac{\sqrt[3]{1.75}}{0.00339}$$

(c.f. 0.003864, Battelli, 1890).

Or, find p_c for CS₂.

$$v_c =$$

$$b \times 10^6 =$$

$$\therefore p^{\frac{1}{3}} =$$

$$0.009011$$

$$3431 \text{ (Battelli, 1890)}$$

$$\frac{3b}{v}$$

$$\therefore p_c = 1.49$$

(c.f. p = 2.17 for CO₂).

If this relationship has any solid foundation, then Van der Waal's equation will become

$$\left(\frac{p + a}{p_c} \right) \left(\frac{v - b}{\sqrt[3]{p}} \right) = R.T.$$

$$\therefore \frac{T_c \sqrt[3]{p}}{P_c b} = \text{a constant.}$$

and from

$$\frac{M P_c}{p + d_c + T_c} = \text{a constant,}$$

and

$$\frac{T_c \sqrt[3]{p}}{P_c b} = \text{a constant,}$$

we obtain

$$\frac{M}{p d_c} \cdot \frac{\sqrt[3]{p}}{b} = \text{a constant,}$$

$$\text{i.e., } \frac{M}{d_c b p^{\frac{2}{3}}} = \text{a constant. See Table IX.}$$

TABLE IX.

	d_c	$b \times 10^6$	p	M	$\frac{M}{d_c b p^{\frac{2}{3}}}$	Observer.
(C ₂ H ₅) ₂ O	0.26	5887	2.1	74	29410	(Galitze, 1901)
	0.2625	6002	2.1	74	29640	(Young, 1910)
CH ₃ COOH	0.3506	4767	1.57	60	26,590	(Young, 1910)
CO ₂	0.464	1912	2.17	44	29,600	(Amagat, 1892)
SO ₂	0.52	2516	2.11	64	29,740	(Cailletet, 1887)
						(Cardoso, 1910)
C ₃ H ₈	0.23?	5390	2.50	70	30,660	(Vespignani, 1903)
H ₂	0.033	977	1	1	31,010	(Dewar, 1902-4)
SnCl ₄	0.7419	7332	2.09	261	29360	(Young, 1910)
A	0.509	1348	2.36	39.9	32820	(Ramsey & Tra- vers, 1901)
						(Crommellin, 1910)
N ₂ O	0.454	1840	2.28	44	30420	(Viliard, 1894)
C ₆ H ₆	0.3045	5369	2.08	78	29270	(Young, 1910)
C ₆ H ₅ Br	0.4853	6872	2.05	157	29170	(Young, 1910)
X	0.94	2303	2.60	130.2	31800	(Ramsey & Tra- vers, 1900)
CH ₃ OH	0.2722	2992	1.71	32	27480	(Young, 1910)
C ₂ H ₅ OH	0.2755	3753	1.94	46	28610	(Young, 1910)
C ₃ H ₇ OH	0.2734	4577	1.945	60	28720	(Young, 1910)

Some of the data used is rather old, but selecting values calculated from the data supplied by the same investigator (Young, 1910), the results appear more consistent.

Ether	28,640
*** Acetic Acid	26,590
Stannic Chloride	29,360
Benzene	29,270
Brom.-Benzene	29,170
Methyl Alcohol	27,480
Ethyl Alcohol	28,610
Propyl Alcohol	28,720

The average is 28,480, so no result is more than 7% different from the mean.

Slight changes in d_c or b would make the numbers still more alike. So I have tentatively accepted the following equations at the critical temperature:—

$$p_c = \frac{M P}{k d_c T_c} \quad \text{where } k = 10.5$$

$$v_c \sqrt[3]{p} = 3b$$

$$\left(\frac{P + a}{v} \right) \left(\frac{v - 3b}{\sqrt[3]{p}} \right) = R.T.$$

$$\frac{T_c + p}{R_c} + S = 22.15$$

$$\frac{M}{d_c b p_c^2} = \text{a constant}$$

$$p_c W s = k$$

(where W = average weight of atoms present and k depends on the critical temp. See *Chem. News*, 1921, Vol. 122, p. 292)

*** In substituting in the formula $\frac{M}{d_c b p_c^2}$ = a constant, the molecular weight used is that of the unassociated molecule. But in the case of acetic acid, etc., some association takes place even in the gaseous state, so that M for these substances is too small, and hence the value of the constant is too small. Gaseous acetic acid, for instance, has a molecular weight of about 60+28,480,

26,590

i.e., 64.2, at its C.T., and contains about 7% of double molecules.

THE INTERACTION OF METHYL IODIDE AND POTASSIUM PLUMBITE.

A COMPARISON OF THE BEHAVIOUR OF ALKALINE SOLUTIONS OF THE HYDROXIDES OF TIN AND LEAD.

By J. G. F. Druce, M.Sc., A.I.C.

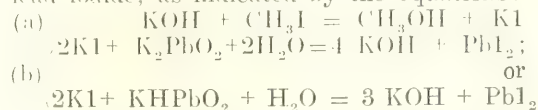
It has been previously found that methyl iodide reacted with an alkaline solution of stannous hydroxide, producing the alkali salt of methyl-stannonic acid, $\text{CH}_3 \text{SnOOH}$ (Druce, *Chemical News*, 1920, cxx., 229; Pope and Peachey, *Proc. Roy. Soc.*, 1903, lxxii., 7; Pfeiffer and Lehnardt, *Ber.*, 1903, xxxvi., 1054).

Since tin and lead are in the same group in Mendeléeff's Periodic Classification of the Elements, it was thought desirable to determine whether a similar organo-metallic acid containing lead could be isolated.

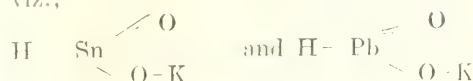
No such compound has, however, been prepared during the course of experiments in which the procedure adopted was the same as in the preparation of the methyl stannonic acid. Alkaline solutions of lead hydroxide were found to react with methyl iodide depositing clusters of crystals of lead iodide.

When carbon dioxide was passed through the filtrate from these crystals, it gave a precipitate containing lead and iodine. No carbon was detected in this product.

In another experiment it is now shown that methyl alcohol is a product of the interaction of potassium plumbite and methyl iodide. Therefore the reactions which took place were that, firstly, the potassium hydroxide present hydrolysed the methyl iodide into methyl alcohol and potassium iodide; then the latter reacted with the potassium plumbite to produce lead iodide, as indicated by the equations:



It will be observed that the second stage of the reaction can be represented in either of two ways according to whether the presence of normal or "acid" plumbite is assumed. The latter would be in accordance with Hantzsch's view (*Zeit. Anorg. Chem.*, 1902, xxx., 289), that when tin and lead hydroxides dissolve in alkalis the hydrogen salts are produced, and have a structure similar to that of the formates, viz.,

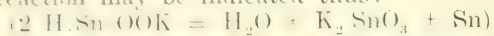


In the case of lead hydroxide, Bechard Austerweil (*Zeitsch. Elektrochem.*, 1907, xiii., 165), found that the limit for those solutions in which the strength of the alkali (sodium hydrate in this case) was below normal. More concentrated solutions were considered to contain some of the normal plumbite, Na_2PbO_2 .

From quantitative experiments, it appears that more alkali than is required to form the normal plumbite must be added in all cases, to dissolve freshly precipitated lead hydroxide (see also Rubenbauer, *Zeit. Anorg. Chem.*, 1902, xxx., 331).

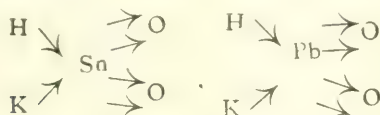
When such solutions were boiled they remained clear. In this respect lead behaved differently from tin.

When potassium hydroxide was added to stannous chloride so that the precipitate first produced had re-dissolved, a solution was obtained, which, on boiling, gave a fine grey precipitate of metallic tin. The filtrate from this precipitate contained potassium stannate, and the course of this reaction may be indicated thus:—



It will be observed that in the structural formula assigned to potassium hydrogen stannite and potassium hydrogen plumbite by Hantzsch (*loc. cit.*), the tin and lead appear quadrivalent, whereas these salts are obtained from divalent compounds of the metals under circumstances which do not admit of any oxidation.

This anomaly in the representation of these compounds is removed if the recent views of Brauner (*Analyse Qualitative*, 1919, Prague, p. 164) on valency are accepted. In such compounds, Brauner considers that the central metallic atom possesses the property of simultaneously increasing its positive valency and its negative valency, each by the same number of units. In the electronic conception of valency this corresponds with the gaining and simultaneous yielding of valency electrons. The total valency remains unchanged, and, denoting the direction in which the electrons are attracted, potassium hydrogen stannite and plumbite can be denoted:—



Thus, tin and lead are seen to have a total valency of $-2 + 4 = +2$.

EXPERIMENTAL.

Lead nitrate (8 grms.) was dissolved in 50 cc. of hot water and precipitated with excess of ammonium hydrate. The precipitate was filtered and washed with hot water until the filtrate was almost neutral. It was dissolved by warming with 100 cc. of potassium hydroxide solution containing 1.2 grms. When this solution was cold, 3.6 grms. of methyl iodide were added, together with 100 cc. of alcohol.

After 24 hours, clusters of pale yellow crystals appeared. More were deposited by the following day. At the end of a week the crystals were isolated and washed with cold water. They dissolved somewhat in hot water, but separated again on cooling. On heating alone they melted at about 370°C . and gave off a small amount of iodine vapour. Other experiments were carried out, and all indicated that the substance was lead iodide.

On analysis 0.3503 gm. gave 0.2241 gm. PbSO_4 ; $\text{Pb} = 43.7$ per cent.; PbI_2 requires $\text{Pb} = 44.95$ per cent. A trace of potassium sulphate was also obtained, but the potassium present in the crystals was less than one per cent.

Carbon dioxide was passed into the filtrate from the lead iodide crystals, and precipitated an almost white product. This was filtered and washed with cold water. It was slightly soluble in hot water, and on examination was found to contain lead and iodine. Thus the solution in hot water gave a precipitate with silver nitrate, which did not dissolve in hot ammonium hydrate solution. Similarly potassium chromate gave a yellow precipitate with the substance in hot water. When the solid was heated with copper oxide, no carbon dioxide was evolved, since the small amount of gas produced gave no precipitate when passed through lime water. A similar result was obtained when the crystals, which first separated were heated with copper oxide.

In a second experiment the same quantities of alkali, lead hydroxide and methyl iodide were used, but the alcohol was omitted.

Lead iodide crystals appeared as before, and the methyl iodide gradually disappeared. The filtrate was distilled, and the first fraction of the distillate was inflammable, burning with a very pale flame which was tinged a bluish colour. The

distillate gave no precipitate with silver nitrate, even after several days; hence, no methyl iodide was present. The rest was again slowly distilled with potassium dichromate and concentrated sulphuric acid. An ammoniacal solution of silver oxide was added to this distillate (which had the odour of formaldehyde), and on warming the mixture a silver mirror appeared. These results were considered to be adequate proof of the presence of methyl alcohol in the products of the interaction of potassium plumbite and methyl iodide.

Another experiment was carried out in which the lead hydroxide precipitated from 8 grms. of the nitrate was dissolved in a solution containing 12 grms. of potassium hydrate and a solution of 4.1 grms. of potassium iodide was added. Again, after standing overnight, granular crystal groups separated as in previous experiments. This was considered to indicate that the lead iodide deposited through the interaction of methyl iodide and potassium plumbite were produced through the intermediate formation of potassium iodide.

A potassium hydroxide solution of stannous hydroxide was made as described in the preparation of methyl stannonic acid (*Chemical News*, 1920, cxx., 229). It was gently boiled for ten minutes.

The grey precipitate which formed was allowed to settle, and the clear liquid was decanted. When this was acidified with hydrochloric acid so that the precipitate (of metastannic acid) first produced had redissolved, hydrogen sulphide was passed through the solution and gave a yellow precipitate of stannic sulphide. Thus the decanted liquid contained potassium stannate. The grey precipitate was washed by decantation and finally filtered, washed and dissolved in hot strong hydrochloric acid with evolution of hydrogen. The solution obtained answered the tests for stannous chloride.

CHEMICAL IMPORTS TO MEXICO.

Replying to Mr. Alfred Short Sir Philip Lloyd-Graeme, Secretary to the Overseas Trade Dept., said that there was a good demand in Mexico for certain British manufactured goods, including heavy chemicals. Local production practically satisfied the demand for some of them; but British trade with Mexico had been maintained.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, APRIL 6, 1922.—*Sir Charles Sherrington, President, in the Chair.*—The following papers were read, the summaries here printed having been supplied by the authors for use at the meeting:—

F. E. SMITH, F.R.S. On an Electro-magnetic Method for the Measurement of the Horizontal Intensity of the Earth's Magnetic Field.

The instrument is the outcome of a suggestion made by Sir Arthur Schuster. It is designed to measure "H" within a few minutes, and with a probable error of only a few parts in 100,000. For constructional purposes as well as to ensure a uniform magnetic field at and near the centre of the system, a Helmholtz-Gauguin arrangement of coils was adopted.

The coils consist of two interwoven helices on each side of the centre; they are of bare copper wire, and are wound in spiral grooves cut in a marble cylinder. Each coil is of 30 cm. radius, of six turns, and of $1\frac{2}{3}$ mm. pitch. The cylinder is mounted on a non-magnetic base, and can be rotated about a vertical axis. The magnet at the centre is 1 cm. long and about 6 sq. mm. in cross-section; it is supported on a V of aluminium foil by a fine quartz fibre, to which is attached also a reflecting mirror and a damping vane. The magnet is easily removed from its support, and a copper wire of equal weight and of nearly the same dimensions can be substituted. This enables most of the torsion of the fibre to be removed.

In practice, the axial magnetic field due to the current in the coils is made slightly greater than "H" and its component in the magnetic meridian opposes H. By adjustment of the angle α between axis of cylinder and direction of magnetic north, the indicator magnet is caused to set at right angles to the meridian. When torsion on the fibre is eliminated,

$$H = F i \cos \alpha,$$

where F is constant of coil system and i is current. The current was measured by the N.P.L. current balance.

A measurement of H, with calculation complete, occupies less than 4 minutes. The probable error of a measurement, in-

cluding the error due to uncertainty of the value of the current, is about ± 4 parts in 100,000.

G. I. TAYLOR, F.R.S. Stability of a Viscous Liquid contained between Two Rotating Cylinders.

1. It is shown that steady motion of viscous liquid contained between two concentric rotating cylinders is unstable for symmetrical disturbances, provided velocity of system is greater than a certain value, and ratio of angular velocities of cylinders less than reciprocal of square of ratio of their radii, or is negative. When the ratio of speeds is greater than this value, instability of the type for lower values of the ratio cannot arise.

2. The type of instability which appears is periodic along length of cylinders, and consists of vortices enclosed in partitions rectangular in section. These vortices rotate alternately in opposite directions as though geared together.

3. When the cylinders rotate in the same direction each vortex extends across the space between the cylinders. In this case the length parallel to axis of cylinder occupied by each vortex is equal to thickness of layer of fluid between them.

4. When the outer cylinder rotates in the opposite direction to the inner, and with an angular velocity $1\frac{1}{2}$ times as great, the disturbed motion consists of two systems of vortices all rotating as though geared together. The outer system, however, is very much less vigorous than the inner.

5. In this case, the space parallel to the axis occupied by each vortex decreases as the radial thickness of the space occupied by the inner vortices decreases, in such a way that the section of the partition filled by each vortex of the inner system remains approximately square.

6. Criteria for stability have been obtained in approximate form suitable for numerical computation in the case when the cylinders rotate in same direction, and in one particular case when the rotations are opposite.

Prof. T. H. HAVELOCK, F.R.S. Dispersion Formulæ and the Polarisation of Scattered Light; with Application to Hydrogen.

Simple types of dispersion formulæ are considered when the medium consists of anisotropic molecules distributed at random, and the polarisation of scattered light is brought into relation with these formulæ. In particular, if the molecules have an axis

of symmetry, the dispersion formula may be written as

$$n - 1 = \frac{1}{2}C [(p_1 - p) + 2(p_2 - p)] = \frac{1}{2} [(n_1 - 1) + 2(n_2 - 1)].$$

The corresponding ratio of the intensities of the two polarised components of light scattered at right angles, when the primary light is unpolarised, is

$$6(n_1 - n_2) / [45(n - 1) + 7(n_1 - n_2)].$$

The case of hydrogen is examined numerically. Two dispersion formulæ of the required type are obtained; further, the ratio of the intensities agrees substantially with Lord Rayleigh's experimental value. Other dispersion formulæ for hydrogen are also examined from this point of view.

G. R. GOLDSBROUGH, D.Sc. The Cause of Encke's Division in Saturn's Ring. Communicated by Prof. T. H. Havelock, F.R.S.

This paper is the continuation of a former ("Phil. Trans.," A, Vol. 222, p. 101), and examines the effect of the inclination of the satellite orbit upon a ring of particles surrounding the planet Saturn.

It is shown that such a satellite will, from its inclined path alone produce one new division in the Ring System.

If the satellite be Mimas, a narrow division closely corresponding to Encke's Division is produced. Similarly, Enceladus should produce a division in Ring B, but reasons are adduced showing that it should be almost unobservable.

C. SPEARMAN. Correlation between Arrays in a Table of Correlations. Communicated by Prof. L. N. G. Filon, F.R.S.

The aim is to show what the correlations between arrays can reveal as to the inward structure of the variables concerned. A method is demonstrated whereby the said correlations between arrays may be expressed as functions of the independent variable elements entering into the main variables. In this way, proof is given that, when only one and always the same element is common to any different variables, then the correlation between every two parallel arrays amounts to plus or minus unity. Conversely, when every two parallel arrays have all their corresponding correlations in any constant proportion, then any different variables can only possess one and always the same element in common.

The correlational coefficients considered are throughout of the ordinary kind, derived from product moments. The proofs are quite general, and, in particular, do not assume any "normal" frequency distribu-

tions. The application has chiefly in view certain fundamental theories of psychology.

Dr. W. L. BALLS. Apparatus for Determining the Standard Deviation Mechanically. Communicated by Prof. J. N. Yule, F.R.S.

This simple calculating apparatus is related to the "Harp" Harmonic Analyser formerly described ("Proceedings," A, Vol. 99, 1921,, similarly utilising separately loaded strings to deflect a yoke upon which they all converge.

The design of the yoke has been so modified as to make the readings quantitative, while each string is loaded in proportion to the square of its deviation from the zero position. A template, representing the frequency curve under examination, is inserted behind the loaded strings, whereupon the movement of an optical lever at once gives the "sum of the squares of the deviations." This reading is then transferred to a monograph to complete the calculation.

The values obtained for standard deviations are correct to within 5 per cent.; they can be obtained much more rapidly than by calculation, and without occupying the time of a skilled computer.

THE OPTICAL SOCIETY.

At a meeting of the Optical Society, held at the Imperial College of Science and Technology on Thursday, 6th April, Sir Frank discussed:—

(1) "Diffraction Halos in Normal and Glaucomatous Eyes," by H. H. Emsley and E. F. Fincham.

Every normal eye, under appropriate conditions, sees diffraction rings or halos encircling bright sources of light. Halos of a similar nature are seen by eyes in certain abnormal pathological conditions, particularly in the case of eyes suffering from glaucoma.

The practical importance, from the oculist's point of view, of a more exact knowledge of the peculiarities of these halos rests upon the desirability of being able to differentiate with certainty between the halos seen by an eye in normal condition and those seen by an eye suffering from glaucoma. Results of observations are given and tests are specified by means of which the different phenomena in the two cases may be identified.

(2) "The Effect of Changes on Surface Curvature at the Focus of an Astronomical Object Glass," by E. Wilfred Taylor.

The correct balancing of the components of a large object glass is necessarily a lengthy and difficult process, and the effect, at the focus, of a similar alteration of curvature at each of the four surfaces, is different. If the effect of an alteration at each of the surfaces is known, the one most suitable may be chosen, having regard to the amount and nature of the aberration it is necessary to overcome.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

ABSTRACT OF PAPER READ BY MR R. BORLASE MATTHEWS BEFORE, ON THURSDAY, 30 MARCH, 1922, AT 6 P.M.

Ancient Craft and Modern Knowledge.

(Continued from Last Week).

So far the application of electricity on the farm is largely a matter of employing methods which have already been tried and found successful in manufacturing industries—a safe and adaptable form of light easily installed in any building, old or new, a flexible means of driving machines independent of the use of fuel, the production of smoke, heat and fire risk, naturally commends itself to the farmer who has once seen it in operation and can get the necessary supply of power, particularly so as experience shows that the actual amount of power required across the year is a very small matter on the farm, but in addition to this it is obvious that we may expect remarkable further developments as electrical engineers give more and more attention to these problems.

Already the use of electric heat has been successfully employed for incubation.

Electric light has been shown capable of increasing the yield of eggs, or at least increasing their yield during that period of the year when they are of the highest market value.

Other applications of electric power full of promise relate to the sterilisation of milk. The treatment of green fodder preserved for winter use by the method known as Ensilage, and last, but not least, there is a wide, and as yet but imperfectly explored, field electro-culture.

It has been known for a long time that plant growth could be stimulated by the discharge of electricity at very high tension in its neighbourhood, although the precise reason for this is yet comparatively obscure.

Recent experiments on a practical scale have, however, demonstrated that an extremely small amount of electrical power converted in suitable apparatus to a very high tension and discharged from overhead wires strung across the fields has a remarkable effect upon most forms of vegetable life, increasing their yield, and in many cases advancing the period of harvest.

Although it is at least possible that this effect may be rather in the nature of a stimulant than a food, and due to some effect upon the plant which enables it to pick up nutriment from suitable land more successfully than it could do unaided, yet there is already sufficient evidence to justify careful and continued research in this direction.

CHEMICAL NOTICES FROM FOREIGN SOURCES

NEW DISTINCTIVE CHARACTERISTICS OF THE THREE PROPANOL-2-CAMPHOCARBONOLIDES FUSING RESPECTIVELY AT 141°, 117°, 118°, AND 89°-90°—*A. Haller and Mme. Ramart-Lucas*.—The two propanol-2-camphocarbonolides, which fuse respectively at 141° and 117°-118°, are derivatives of the isomeric allylcamphocarbonates, and the former possesses the configuration of a *cis-trans* molecule, and the latter that of a *cis-cis* compound. This difference of configuration results from the fact that the olide of melting point 141° yields a propanol-camphocarbonic acid which can be isolated as such, while the isomer fusing at 117°-118° does not give a stable acid alcohol, but lactonises as soon as it is set free from its sodium salt. This difference of behaviour furnishes a means of separating the two isomers. The third isomer of melting point 89°-90°, when subjected to the same

treatment, gives a β propanolcamphocarbonic acid which differs from the α compound both as regards its temperature of decomposition (115°-120°), and as regards the solid camphopropanol (m. pt. 100-101°) to which it gives rise. The phenyl urethane of the last alcohol differs from that of the isomeric alcohol in the nature of its crystals and in its rotatory power.—(*Comptes Rendus*, CLXXIV., 1922, No. 12.)

PREPARATION OF ETHYL CARBAMATE—*L. Guerci*.—Having occasion to prepare considerable quantities of ethyl carbamate, the author found that the usual method of making nitrate of urea react with absolute ethyl alcohol in a closed tube at 130° was inconvenient, although the yield was good, and he has discovered a cheaper and better method. It depends upon the action of nitrate of urea upon absolute alcohol in presence of sodium nitrate. The absolute alcohol and nitrate of urea are heated together (3 kg. of the former to 1 kg. of the latter) on a water bath to a temperature of 60-70°, and the sodium nitrate is added gradually in small portions of about 25 gr. so that about 561 gr. are added altogether in the course of two hours. The reaction is allowed to proceed on the water bath for another hour, and then the absolute alcohol is rapidly distilled off under reduced pressure. Thus an oily mass is obtained, which solidifies on cooling. It is extracted with benzene, and the solvent is finally distilled off; the urethane then crystallises in beautiful needles which melt at 47-50°. The yield is about 80 per cent. of the theoretical yield.—(*Giornale di Chimica Industriale applicata*, IV., 1922, No. 2.)

ACTION OF LIGHT UPON URANIC SALTS—*J. Aloy and E. Rodier*.—To make a systematic study of the action of light upon uranous salts, the authors have used aqueous (or sometimes alcoholic) solutions containing from 1 to 5 per cent. of uranyl salts. The solutions also contained some substance which could be oxidised (aldehyde, ether, alcohol, glucose, etc.), and a variable quantity of the acid corresponding to the salt used. If R denotes a monovalent acid radical, and UO_2R_2 a salt of uranyl, the transformation of this salt into the normal uranous salt under the influence of light and in presence of an oxidisable substance can be represented by the equation

$\text{UO}_2\text{R}_2 + 2\text{RH} + \text{A} = \text{UR}_2 + \text{H}_2\text{O} + \text{A O}$. The substance represented by A may be an alcohol which is converted into aldehyde or acid. The equation shows the need for the presence of a certain quantity of free acid in the solution. The reaction can be followed qualitatively by the examination of the very characteristic absorption spectrum of uranous solutions and quantitatively by determinations with potassium permanganate. Usually a green solution of the uranous salt is obtained, or in exceptional cases the salt is precipitated. By this method the authors have obtained UF_4 , UCl_4 , and hydrated uranous sulphate $\text{U}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$, but have not succeeded in isolating uranous nitrate. When the quantity of free acid is insufficient the uranous salt formed is decomposed, an insoluble basic salt being formed. Thus a light green precipitate of a basic uranous chloride can be obtained, but no definite crystalline compound has been isolated, and the composition of the precipitate seems to depend upon the conditions of the experiment. The dark brown colourations with or without black precipitates, which have been mentioned by several authors, are the result of a more advanced decomposition of uranous salts under the combined influence of light and solar heat. All the uranous salts obtained suffer this decomposition provided that the liquid is only slightly acid and the action of light is long enough. A black precipitate can also be obtained without the intervention of light if the slightly acid solutions of uranous salts are heated with a sufficient quantity of water.—(*Bull. Soc. Chim.* XXXI.-XXXII., 1922, No. 3.)

GENERAL NOTES

CHEMICAL FACTORY CONDITIONS.

Mr. Shortt, Home Secretary, replying in the House of Commons to a question by Mr. Wignall, said that the conditions in the chemical industries had been the subject of special investigation, and draft Regulations under Section 79 of the Factory and Workshop Act, 1901, had been under discussion with the industries for some time past. These Regulations, which it was hoped to bring into force very shortly, would require the provision of protective clothing and other welfare arrangements for persons employed in a number of processes liable to

cause special danger to health. It was originally hoped to apply these arrangements more widely, but in view of the expense entailed, and other circumstances, it had been necessary for the present to limit them to the specially dangerous processes.

BRAZILIAN DYE TRADE.

Lieut.-Col. Sir John Norton-Griffiths asked the President of the Board of Trade whether steps would be taken with his active support and that of his department to counteract the impression now being made in the Brazilian aniline dye trade by officially supported corporations of German traders; and whether he would consider the desirability of investigating the means by which such steps might conveniently be taken, and of reporting upon the same, for the benefit of British traders to whom the Brazilian dye trade was of so much importance, having regard to its prosperity in 1919 and 1920.

Mr. Baldwin replied: I shall be glad to consider any information and suggestions on this matter which my hon. and gallant friend may care to send to me, and to draw the attention of British dye manufacturers to the importance of the Brazilian market. I would point out, however, that the present depreciated state of the German exchange gives the German manufacturers a very substantial (though it may be only temporary) advantage in respect of export trade.

IMPORTED ARSENIC.

Sir Edardd Nicholl asked the President of the Board of Trade if he had received any complaint that arsenious acid was being imported into this country under the name of arsenic or powdered white arsenic, which corresponded with the definition of the arsenious acid which was dutiable according to the list of the Board of Trade drawn up under the provisions of the Safeguarding of Industries Act (List H), and that such imports were not bearing the duty imposed by the Act.

Mr. Baldwin replied: A complaint has been made that arsenious acid which is being imported under the names mentioned by my hon. friend is, in fact, of the grade included in the Board of Trade list, and is

therefore chargeable with duty. I am, however, unable to agree that the heading in question covers ordinary refined white arsenic of the grades generally used in industry.

Sir Edward Nicholl asked in what respect industrial-grade arsenic differed from the dutiable article as included in the Board of Trade list.

Mr. Baldwin said that industrial grade arsenic differed from the dutiable article in that it was produced and refined on a large scale by processes which would not be regarded as fine chemical processes, but were in the nature of metallurgical processes, whilst the dutiable article was produced by typically fine-chemical processes for use, for instance, as an analytical reagent. The standard of purity required for the reagent was higher than that of the ordinary industrial grades.

DIAMOND CUTTING.

The experiment of Sir Bernard Oppenheimer in establishing a diamond-cutting factory to utilise the labour of disabled soldiers appears to have met with striking success. Beginning on a very small scale in July, 1917, it has now developed into the largest diamond-cutting factory in the world, and the English seaside resort, Brighton, is destined to figure as a prominent centre of the diamond industry, alongside Antwerp and Amsterdam. At the end of 1920, as many as 700 hands were employed here, and provision has been made for increasing the number of workers to 2,000. During the first six months of training the men receive an allowance from the Ministry of Labour, in lieu of their pension, no wages being paid to them by the firm, but free expert instruction being provided for them. At the expiration of the six months' training, the ex-soldier again receives his pension from the Ministry of Pensions, and is given a weekly wage of £2 by the firm. As he becomes more proficient, his remuneration is increased, and by the end of his first year an average cutter earns £3 a week; in the second year this average rises to over £5 a week. If expectations are fulfilled, the British Empire will soon be not only the chief producer of diamonds, but will also have a large share of the profits derived from cutting the stones mined in British dominions.

As an indication of this, it is stated that diamonds valued at £500,000 have not long since been shipped to Antwerp. In addition, orders from the East have

reached a value of £300, and exports have been made to Paris and New York. A diamond weighing 600 carats, the largest received up to the middle of November, 1920, was cut into 10 stones of considerable size and a number of smaller ones. The industry does not depend solely upon South African diamonds, for rough diamonds to the value of £250,000 have been received from British Guiana and cut at Brighton. The machinery used is manufactured in Sussex County, and thus any needed part can be duplicated and replaced with very little delay. As has been stated, the work at Brighton is done exclusively by disabled soldiers of the world war, instructed in the diamond-cutters' art by expert Belgian workers who sought refuge in England during the German occupation of their native country.

FINE CHEMICALS.

We have received from the Association of British Chemical Manufacturers a list of the British fine chemicals produced by the members of the Association. The list is dated March, 1922, and occupies close upon 40 pages of chemical preparations arranged in alphabetical order, together with a series of index numbers which give the names of the manufacturers producing them.

The list is very encouraging, on account of its completeness and the means of being able to tell in a moment where to procure any of the reagents will be of the greatest value in the laboratory.

In addition to the chemical compounds enumerated, a list of the indicators in common use is given, and also one of dry microscopic stains.

We notice that there are only 38 firms whose names are given as manufacturers, and we hope that in the near future this number will be largely increased.

The proceedings at the monthly council of the Royal Agricultural Society of England, which has just come to hand, show that a large amount of valuable work is being carried out. A short section dealing with the chemical examination of fertilisation and feeding stuffs shows the need for careful examination of products that find their way into the market with glowing advertisements. One case is recorded of material that was sold as a "fertiliser and purified" at £7 per ton, and was found to consist of nothing more than waste lime of inferior quality, worth not more than 50s. per ton. Barley meal was found to con-

tain much sand, &c. These cases are being followed up, and the work will probably be extended in the near future.

LONDON COUNTY COUNCIL.

INTERMEDIATE TECHNICAL SCHOLARSHIPS, 1922.

The Council is prepared to award Intermediate Scholarships and Free Places in the undermentioned senior day technical courses:—

Engineering.—Northampton Polytechnic, Battersea Polytechnic, Finsbury Technical College.

Technical Optics.—Northampton Polytechnic.

Building.—L.C.C. School of Building, Northern Polytechnic, Regent Street Polytechnic (Architecture).

Chemical Trades (General).—Battersea Polytechnic, South Western Polytechnic, Finsbury Technical College, Northern Polytechnic (Works Chemists' course).

Chemical Trades (Special).—Leathersellers' Company's Technical College (leather manufacture), Northern Polytechnic (rubber), Borough Polytechnic (bakery and confectionery).

Musical Instrument Making.—Northern Polytechnic.

Boot and Shoe and Light Leather Manufacture.—Cordwainers' Technical College.

The scholarships and free places are, as a rule, tenable for two or three years, but not beyond the end of the school year in which the age of 19 is attained. They provide free tuition in approved courses, and (in certain cases) an annual grant, determined in accordance with the scale set out in Schedule 3 on page 48 of the Council's Scholarships and Training of Teachers Handbook, which can be purchased through any bookseller or direct from the publishers, Messrs. P. S. King and Son, 2 and 4, Great Smith Street, Victoria St., Westminster, S.W.1, price 3d., by post 4½d. From this schedule it will be seen that if the income of the parents (or guardians) is £550 a year, and there is no other child, the candidate will be ineligible for a scholarship or free place.

Candidates must be less than 18 and not less than 16 years of age on 31st July, 1922. They must be British subjects, and their parents (or guardians) must be ordinarily resident within the administrative County of London.

The selection will be made on the result of an approved "first" examination or, in special cases, on the reports of a Board of Assessors who will interview candidates.

Application forms T may be obtained from Room No. 539, New County Hall, S.E.1, and they must be returned not later than 1st May, 1922.

R. BLAIR,
Education Officer

Education Officer's Department,
New County Hall, S.E.1.
January, 1922.

SOUTH WESTERN POLYTECHNIC INSTITUTE.

An announcement is made of a course of 10 lectures on the "Chemistry and Technology of Petroleum," to be given on Thursday afternoons at 2 o'clock at the Polytechnic, Manresa Road, Chelsea, S.W.3. The lectures will commence on April 22. A practical class will be held immediately after each lecture at which demonstrations will be given of the apparatus and methods employed in testing and examining petroleum and petroleum products. The fee for the course is 10s. Further information can be obtained by applying to the head of the Chemical Department.

We have received the following announcement from the Editor of the *Yorkshire Evening News*, with request for publication:—

FRANCO GERMAN ENTENTE.
SENSATIONAL DYES AGREEMENT WITH GREAT
FATHERLAND TRUST.

GERMANS TO HALVE FRENCH PROFITS.
(Exclusive to the "*Yorkshire Evening News*.")

The *Yorkshire Evening News* is in a position to make public the particulars of a remarkable commercial alliance which has been concluded between Germany and France. It is understood that the leading French dyestuffs company, "La Compagnie Nationale de Matières Colorantes et de Produits Chimiques," has come to an arrangement with the Interessen Gemeinschaft, the great German Dye Trust, commonly known as the "I.G." The Germans have agreed to give France all the technical assistance in their power. They will disclose the secrets of their laboratories; they will tell how these are carried out; they will furnish copies of their plant designs; they will even send trained German chemists into the French factories to superintend their secret processes in the actual manufacturing operations. The French, on their part, have undertaken that their output of dyestuffs shall be confined to the demands of France and her colonies, and they consent to hand over to the Germans fifty per cent. of their profits.

THE "RADIO REVIEW."

From April 1st, the *Radio Review* is being incorporated with the *Wireless World*, and that in future the publication will be known as the *Wireless World and Radio Review*, and will be issued weekly.

The Journal of the Franklin Institute for March, 1922, contains an important paper upon Fogs and Clouds by W. J. Humphreys, C.E., Ph.D. The paper is accompanied by a large number of extremely fine photographic reproductions of clouds.

The subject is very exhaustively treated, and at the end will be found a discussion on clouds as weather signs. The paper concludes with a bibliography of the literature of the subject.

The same journal gives a valuable paper upon the production of Gasoline from oil shale, with a good deal of real information about the occurrence of oil shale in Utah, accompanied by photographic illustrations.

Much has been written recently in the Press about the possibilities of the production of oil from this source, and the paper will be found of value to those interested in the matter.

NOTES ON BOOKS.

The Storage of Petroleum Spirit and Carbide of Calcium for the use of local inspectors and motorists, by MAJOR A. COOPER-KEY, C.B. Second Edition; pp. x. + 133. London: Charles Griffin and Co., Ltd., 1921.

The author has prepared a convenient "primer" for the use of officials and for those who need, for any reason, to store petrol or calcium carbide.

He is exclusively concerned with the legal aspect of the subject, and only deals with the chemical and other tests, and with the properties of the various products in so far as these have a bearing upon the carrying out of the Petroleum Acts and Orders. These Acts and Orders, 1871—1919, are given in the form of useful appendices.

For those concerned, this little volume will be found very useful. J.G.F.D.

Fixed Oils, Fats, Butters, and Waxes: Their preparation and properties, and the Manufacture therefrom of Candles, Soaps, and other Products, by C. R. ALDER WRIGHT, D.Sc. (LOND.), B.Sc. (VICT.), F.R.S. Third Edition, revised and greatly enlarged by C. Ainsworth Mitchell, M.A. (Oxon), F.I.C.; pp. xiv. + 940 + 3 plates. London: Charles Griffin & Co., Ltd., 1921. Price 56s.

This invaluable treatise has now reached its third edition, and it completely maintains the high standard of excellence reached by its predecessors. The literature relating to the chemistry and technology of fixed oils and fats is already voluminous, and yearly increases. The selection of important achievements and advances from among the numerous publications is a difficult one. The authors have accomplished this task in bringing their volume up-to-date.

The scope of the work embraces the general composition and nature of oils, fats, waxes and allied bodies, and their physical and chemical properties, etc. Industrial and analytical processes are given very fully, and the same applies to the authors' treatment of the candle and soap industries. All the processes that these substances undergo for their various uses are adequately described. The illustrations are also very well executed.

We think, however, that such well-known authorities might have given more guidance to the uninitiated by indicating which analytical processes were those commonly adopted at the present time. All methods receive equally detailed treatment.

Two appendices deal respectively with reports on standard analytical methods issued by the Ministry of Food, and with the important subject of Vitamines.

The authors and publishers have spared no efforts to make the book of the greatest utility to chemists, who will find it most invaluable and indispensable as a standard work of reference. J.G.F.D.

The Elements of Fractional Distillation, by C. S. ROBINSON; pp. ix. + 205. New York: McGraw-Hill Book Co., Inc., 1922. Price 12s. 6d. net.

Apart from Sydney Young's classical volume, very few books have appeared in English which deal with fractional distillation.

In the present volume the principles of fractional distillation are explained in accordance with our knowledge of Physical Chemistry and Chemical Engineering.

Early chapters deal with the subject from the qualitative standpoint of the Phase Rule, and the more important laws of physical chemistry are discussed in so far as they concern distillation phenomena. The quantitative aspects are then considered, especially from the view-point of the chemical engineer. Intermittent and continuous processes of fractionation are compared. The separation of pure ammonia from the crude liquor, benzene from light oil, methyl alcohol from wood spirit, and ethyl alcohol from fermentation products are adequately described. These processes are illustrated with excellent figures which enhance the value of the book. An appendix supplies very useful information in the form of Vapour Pressure curves, tabular data, and a bibliography.

We notice that, although the book generally attains a high standard whenever dealing with industrial matters, little is said concerning steam distillation. A few other minor errors occur. The text on page 12 does not quite agree with the lettering of the figure. In the table on page 190, quino-line is spelt in German, evidently just as it is taken from Rechenberg's treatise; "Chimie" is wrongly spelt twice on page 198.

These small and obvious mistakes should not detract from the unquestionable value of this important work. J.G.F.D.

BOOK NOTES

Readable School Physics, by A. J. COCHINE, B.Sc. Published by G. Bell & Sons, Ltd., London, 1922. Price 2s. 4d.

As might be gathered from the title, the author has endeavoured to present the subject of elementary physics in such a manner as to engage the interest of the young student. The book is quite small, occupying only some 31 pages, and is profusely illustrated. Half-tone pictures are given of many of the prominent leaders in science, and many interesting drawings from ancient and modern works.

At the present day, when the need of the universal knowledge of at least the elements of practical science is becoming fully

recognised, this little work will be found of the greatest possible value. The subject is certainly introduced, as the title suggests, in a readable form, and it is just the book to give to any boy, or girl either, who has the desire for scientific knowledge. The author's method of teaching is very similar to that employed by the late Professor Pepper in his well-known *Playbook of Metals*, dear to many of us in our younger days. We can confidently recommend the book for use both at home and in schools, and we hope that the author will soon see his way to produce a similar work dealing with elementary chemistry.

Directory of Papermakers of the United Kingdom for 1922. 64th annual publication. MarCHANT, SINGER & Co., 47, St. Mary Axe, E.C.3. Price 5s. net.

The *Papermakers' Directory* has been revised and brought up-to-date, and it contains lists of papermakers in the United Kingdom, papermakers' representatives, London wholesale stationers, &c. In addition to the above information there is given a complete list of the watermarks used by papermakers, arranged in alphabetical order, with the name of the manufacturer.

This section is followed by a similar one devoted to trade names—not being actual watermarks.

At the end of the book there is given a collection of paper trade customs, etc., which will be found of great value to stationers and publishers. The book contains a great number of advertisements, classified so as to form in itself a useful directory of papermakers and suppliers. J.H.G.

Lektrik: Lighting Connexions. 7th Edition, 80th thousand. A. P. LUND-berg & Sons, Pioneer Electrical Works, 477/489, Liverpool Road, London, N.7. Price 1s., post free 1s. 2d.

This handy little treatise on electric connexions and switches gives full details of the various methods of connexions used in present day electric lighting. The booklet will be found of the greatest value to practical electricians, who indeed cannot afford to be without it.

Full details are given of a scheme for free home examinations in electric light switching, which has already proved to be of the greatest use to practical electricians. In this 7th edition many improvements in

present-day wiring have been introduced, and the book has been very thoroughly revised. The illustrations given are clear and easy to follow. The work is clearly printed on good quality paper, and is not too large to be conveniently carried in the pocket. J.H.G.

Organic Chemistry, or the Chemistry of the Carbon Compounds, by VICTOR VON RICHTER, edited by Prof. R. Anschütz and Dr. H. Meerwein. Vol. II., Chemistry of the Carboxylic Compounds. Translated from the eleventh German edition by E. E. Fournier d'Albe, D.Sc., A.R.C.S. London: Kegan Paul, Trench Tribner & Co., Ltd., 1922. Price 35s. net.

Richter's "Organic Chemistry" has now become so indispensable as a book of reference for organic chemists that this volume, which is a translation of the German edition of 1912, will find a place in many scientific libraries.

The present edition has been somewhat enlarged to include recent discoveries. The most important interpolations are those incorporating new work on the polymethylenes, halogen and nitrogenous derivatives of the hydrocarbons, phthaleins, condensed nuclei and glucosides.

The discovery of the long sought o-benzoquinone fills a previous gap; other new and more complex quinones are also included. The exceedingly numerous researches made in terpene chemistry have considerably enriched the section of this subject.

The translator has retained the German names for benzene and its homologues, viz., benzol, etc., and on page vi. has translated *Kohlenwasserstoff* into *Carbohydrate*!

Organic chemists whose knowledge of German is slight should prefer the present volume to other works or references of this type.

Recent Advances in Physical and Inorganic Chemistry, by A. W. STEWART, D.Sc., with an Introduction by the late Sir William Ramsay, K.C.B., F.R.S. Fourth Edition; pp. xvi. + 286 + 1 plate. London: Longmans, Green & Co., 1920. Price 18s. net.

This edition of Professor Stewart's "Recent Advances in Physical and Organic Chemistry" contains new matter not in-

cluded in its predecessor. The chapter dealing with the position of the Rare Earth elements in the Periodic Classification has been extended. Results of recent investigations on mass-spectra, transmutation and isotopes have been incorporated. A new chapter has been written on the Periodic Law, and modifications have been made in the Atomic Volume curves. To make room for this matter the chapters on the Pseudo-acids and the Inert Gases have been deleted. The author has generally selected suitable material for a textbook which is widely read by students. However, some of the matter can scarcely be claimed to fall within the domain of chemistry. Recent work on X-rays and positive-ray analysis is highly important, but is more likely to be sought in up-to-date textbooks on pure physics. The long chapter on Absorption Spectra could have appeared equally well in the author's companion volume, "Recent Advances in Organic Chemistry."

The four-page attack on Ostwald appears undignified in view of the international inter-dependence of science and scientists, and also represents no recent advance in Chemical Science.

Students will consult this readable volume to gain information on the latest developments in chemistry, and except for a few controversial hypotheses and the above mentioned points, the author has presented them with a very suitable volume.

The Analysis of Dyestuffs and their Identification in Dyed and Coloured Materials, Lake-pigments, Foodstuffs, Etc., by ARTHUR G. GREEN, M.Sc., F.R.S., F.I.C. Third Edition; pp. xii. + 150. London: Charles Griffin & Co., Ltd., 1920. Price 10s. 6d.

Since the first edition of this book appeared in 1915, the dyestuff industry has experienced considerable developments, particularly in England and America. Dyestuffs previously made only in Germany are now manufactured here, and many have received new trade names. Since the author regards them as of ephemeral nature, he does not include them in his thirty-one analytical tables, but he has indexed them with cross references to the older names.

The important new feature of this edition is Doctor J. M. Matthews' alphabetical tabular "Key to Trade Designations."

In this particular branch of applied chemistry there is a great need for simplification of the nomenclature. The book will be of great service to analysts who are in any way concerned with dyestuffs.

Isotopes, by F. W. ASTON, M.A., A.I.C., F.R.S.; pp. viii. + 152. London: Edward Arnold & Co., 1922. Price 9s. net.

As long ago as 1886 Sir William Crookes urged the possible heterogeneity of the elements, and suggested that the metal calcium for instance, might contain some atoms of Atomic Weight 39, and others 41, or 38 and 42, etc. His laborious fractionations of the rare earth salts had brought him to this conclusion. Radioactive disintegration has more recently (1910) given renewed prominence to his views. The recent results of positive-ray analysis have now confirmed these conclusions, and there is a marked tendency at the present time to revert to a modification of Prout's hypothesis.

The present knowledge of the existence of two or more of isotopes in the case of about fifteen elements gives a satisfactory explanation of the constancy of the chemical atomic weights which are also in excellent agreement with the mean atomic weights deduced by means of the Mass Spectrograph.

Attention is thus drawn to the unsatisfactory definitions given to the term "element," none of which satisfy the demands of the human intellect.

Much has been attempted in order to effect the separation of isotopes. Various ingenious methods of diffusion and fractional distillation have been tried.

Photochemical methods have also been suggested. So far these have met with a very limited amount of success.

Comparatively little is said concerning the Radioactive isotopes, but the author trusts that some other investigator in this field will produce a monograph dealing exclusively with them.

It is regrettable that several errors have been made in the references to the literature. Thus, on page 141 and in the index, Professor Brauner's name is spelt "Braun."

The author has prepared this volume to meet the requirements of teachers and students of Physics and Chemistry who wish to acquire a knowledge of this subject which has recently assumed an important position. He has succeeded in presenting his subject in an interesting manner, which will appeal to those who cannot wade through the literature for the scattered papers on the subject.

GENERAL NOTES---Continued.

AUSTRALIA.

TENDERS INVITED FOR DRY AND POROUS CELLS AND ACCESSORIES.

His Majesty's Senior Trade Commissioner in Australia has informed the Department of Overseas Trade that the Postmaster-General's Department at Melbourne is inviting tenders for the supply of Sulphate of Copper (Schedule No. 16); Dry Cells (Schedule No. 18); Ammonium Chloride (Schedule No. 15); Porous Cells (Schedule No. 17).

Sealed tenders, on the proper forms, are to be received by the Deputy Postmaster-General, Melbourne, up to 3 p.m. on the 23rd May, accompanied by a preliminary deposit based on the following sliding scale and calculated on the total amount of items tendered for:—

- (a) For amounts up to £500, 2 per cent.
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- (c) Minimum deposit is £2 for each tender.

Specifications, conditions, and tender forms relating to the above contract have been received, and may be consulted by United Kingdom firms interested on application to the Department of Overseas Trade (Room 50), 35, Old Queen Street, S.W.1, while one set of the documents is available for loan to firms in the provinces unable to arrange for inspection in London.

Local representation is essential, and the Department will be pleased to supply United Kingdom firms not already represented in Australia with the names of agents who may be willing to act for them.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 8459 Barton, G. V. Apparatus for manufacture of lead oxide. March 21.
 - 8483 Chemische Fabriken Griesheim Landshoff & Meyer Akt Ges. Process for production of an anti-syphilis substance. March 23.
 - 8495 Evans, E. V. Purification of gases from hydrogen sulphide. March 20.
 - 8375 Inray, O.Y. Manufacture of a derivative of pyradolone and of dyestuffs therefrom. March 22.
 - 8172 Lebbin, G. Process for production of carbonic acid baths. March 21.
 - 8615 Lessing, R. Manufacture of neutral sulphate of ammonia. March 24.
- Specifications Published this Week.*
- 176,409 Pattison, E. W. Recovery of ammonia in the ammonia soda process.
 - 174,938 Fleischer, Dr. E. Manufacture of coal distillation products.
 - 176,588 Pearson, A. Manufacture of zinc oxide.
 - 181,757 Merck, E. Process for the preparation of tropinone mono-carboxylic-acid esters.
 - 176,729 Dyson, W. H. Purification of ores and residues containing oxides of chromium.

Abstract Published this Week.

Protecting Unstable Substances. Patent No. 174,891.—A treatment of sodium hyposulphite, sodium perborate, and other per-salts has been invented by Mr. A. Welter, of Rheinhafen, Krefeld, Germany.

Unstable or hygroscopic compounds or mixtures such as oxidising and reducing agents, particularly sodium hyposulphite and sodium perborate and other per-salts are rendered stable by spraying on to the powdered material while in motion a liquid protective material such as water-glass solution, preferably while cooling and drying. The product is in granular form. Preferably the process is effected by spraying the liquid into the upper part of a tower introducing the pulverised chemical, for instance by suction or compressed air, into the spray, and directing an air current so as to meet the moistened particles in their descent to effect the drying.

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PATENTS AND DESIGNS ACTS, 1907 AND 1919.

PHENOL PRODUCTS.

THE PROPRIETOR of British Letters Patent No. 9291, of 1914, is prepared to sell the Patent or to license British Manufacturers to work under it. It relates to an improved method of manufacturing condensation products of phenol and substances containing the methylene radical.

Address:—B. W. & T.,

111 & 112, Hatton Garden.

London, E.C.1.

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3237.

PLATINUM.

BY GEORGE F. KUNZ.

The platinum industry is gradually emerging from the chaotic condition into which it was thrown by the cutting off of the Russian supplies, and by the coincident intense demand for the metal in connection with the manufacturing of war materials. The Russian sources, both new and old, are slowly coming to the front again, and the increased production in Colombia, at first greatly stimulated by the cessation of Russian shipments, has been rendered more stable and promising by the organisation of powerful companies, financed in the United States. At the same time some much-needed laws have been enacted to insure the purity of articles purporting to be made of platinum or of the other platinum metals. Although the special war demand has largely ceased, its place is taken by a revival of the demand for jewelry and dental uses, while the needs of the chemical industries are constant and permanent. As a result of these various factors the price of platinum, although it has fallen decidedly from the high mark of 1919 and the first half of 1920, maintains itself at from 70 to 75 dollars an oz., and it does not seem likely to fall much beneath these figures. Iridium, however, because so much rarer, and because of its necessary employment to give hardness and stability to pure platinum, continues to command a much higher price per ounce than the latter metal. Taken in its entirety, the present aspect and the future prospects of the platinum industry are such as to encourage every effort to open up new sources of production and to develop more extensively the older sources.

The Platinum Stamping Law of New York State, which went into effect Sept. 1, 1920, does not require that a manufacturer shall stamp any article made of platinum, but merely provides a standard for stamping in case the dealer wishes to set such a mark on such of his wares as contain platinum. Nevertheless this law provides an effective guarantee for a purchaser against any misrepresentation on the part of the dealer, for if an article is made of

platinum, in combination with the metals resembling platinum, and a dealer stamps, bills, or marks this article as being of platinum, it must conform to the standard of 925 thousandths fine, or else the law has been violated. Moreover, the dealer may not take refuge in his ignorance of the lack of conformity to the standard, for he is regarded as responsible for the genuineness of the article he sells, that is to say, for its conformity to the stamp or mark it bears, or to the designation under which he sells it. The term "platinum," however, includes all metals of the platinum group, the totality of such metals being included in the 925 thousandths required by the law.

The decision of the Board of United States General Appraisers, rendered Dec. 30, 1920, was believed to settle definitely the status of irido-platinum sheets as imports, and to affirm the claim that they share in the provisions of paragraph 578 of the tariff act of 1913, exempting "platinum, unmanufactured, or in ingots, bars, plates, sheets, wire, sponge or scrap," and are not subject to the 50 per cent. *ad valorem* duty imposed in paragraph 167 on "articles or wares, composed wholly or in part of platinum." The fact that platinum needs the added hardness imparted by an admixture of iridium in order to render it satisfactorily available for industrial or artistic uses, is too well known to require notice here.

The great rise in the value of platinum has caused an urgent demand for it in a quarter whence this demand is not desired. We mean from that section of the community whose members live by thieving. Not long since, a New Jersey manufacturing concern reported that 75,000 dollars of the precious metal had been stolen; a good portion of this has been fortunately recovered, it is said. It is not stated, however, that equal good luck has been enjoyed by the Department of Agricultural Chemistry at the University of Missouri, from whose vault had been stolen the entire stock of platinum crucibles, weighing in the aggregate as much as 2,500 grams, worth nearly 6,250 dollars at present rates. Other institutions also are said to have been despoiled in this way. Indeed, in one instance an entire university laboratory was burned down to hide the theft of platinum. Chemical laboratories and mineralogical museums seem to be the greatest sufferers, unhappily in many cases through those employed in them.

It has been suggested by Dr. W. F. Hillebrand, Chief Chemist at the Bureau of Standards, that a stop might be put to the platinum thefts if a proper system of platinum registration should be required. As the only really effective legislation on this matter ought to have a national scope, and be enacted by Congress, it would be necessary to have it based upon conditions affecting interstate commerce, so as to bring it within the sphere of congressional prerogative, unless, as has also been proposed, the matter could be brought under the control of the internal revenue department, by levying a very small sales tax upon platinum. This tax need not exceed one-tenth of 1 per cent., just enough to pay for the expense of the registering agencies. The importance of some such legislation is emphasised by the fact that on one occasion more than 10,000 dollars worth of platinum was stolen from the Bureau of Standards, and the University of Michigan and the University of Wisconsin have also been sufferers in this way. A still heavier loss, of 40,000 dollars worth of the metal, was inflicted upon a manufacturer in the neighbourhood of New York City. It is also reported that there were taken from the U.S. Smelting, Refining, and Mining Co., of Midvale, Utah, on Feb. 20, 1920, apparatus amounting to 5 oz. troy, while from the chemical laboratory of Wells College, between Feb. 12 and 15, 1920, thieves made off with a number of platinum articles weighing about 16 troy oz. With platinum at 70 dollars or 80 dollars an ounce this constitutes a serious loss.

An adequate idea of the value of recent platinum thefts is given by two trials before the Federal Court at Nashville, Tenn., on April 7, 1921. In the first case the jury found a verdict of guilty against the accused, on a charge of embezzling 26,000 dollars worth of platinum from the Government, while he was employed as chief chemist at the Old Hickory powder plant at Nashville. The same offender was charged with having embezzled 188,200 worth of platinum, in addition to the 26,000 dollars involved in the first trial, and was found guilty on this charge as well.

A novelty in the art of thieving platinum is reported from France. On the towers of the famous Cathedral of Notre-Dame in Paris, the lightning rods have been tipped with platinum as a protection against heaven's artillery. This circumstance in-

duced a gang of thieves to cut their way through a panel of the massive oak door leading the way to the tower stairway, and to perform the same operation on three other successive doors. Once on the platform of the towers, they sawed through the copper lightning rods, and dismantled them so that they were able to take off the platinum balls with which they were tipped. These weighed about half a kilogram, or 16 oz., worth at least 1,000 dollars, or about 13,000 francs at present exchange. Another similar case is the reported stealing of platinum lightning-rod tips from three of the French forts on the Italian frontier.

UNITED STATES PLATINUM PRODUCTION AND IMPORTS IN 1920.

Estimates of the production of crude placer platinum in the United States in 1920 give Alaska, 27 oz. troy; California, 656 oz.; Oregon, 23 oz.; and Washington, 8 oz.; total, 714 oz. troy.

Refiners reported a production of 41,544 troy oz. of new platinum metals in 1920, of which 36,015 oz. was platinum, 418 oz. iridium, 409 op. osmiridium, 4,309 oz. palladium, and 393 oz. of the minor platinum group metals, including rhodium and osmium. This represents a decrease of 3,565 oz. as compared with the production in 1919.

Chem. Met. Eng., July, 21, 1920.
U.S. Geol. Surv.

There was also produced 57,710 oz. of secondary platinum metals in 1920, of which 51,255 oz. was platinum, 3,355 oz. iridium, and 3,100 oz. palladium. This represents a decrease of 3,806 oz., as compared with the production in 1919.

The platinum metals imported for consumption in 1920 included 80,955 oz. of crude platinum and unmanufactured ingots, bars, sheets, etc., of which approximately 58,009 oz. is believed to be refined metal; 4,718 oz. of iridium; 4,473 oz. of osmiridium; 6,944 oz. of palladium; 2,675 oz. of the minor metals; and 781 oz. of manufactured platinum ware.

The consumption of platinum metals in the United States in 1920 was 141,041 oz., of which the jewellers took 57 per cent., the electrical industry 19 per cent., the dental industry 11 per cent., the chemical industry 10 per cent., and miscellaneous uses 3 per cent.

The stocks of platinum metals at the end of 1920 amounted to 67,508 oz., which is an increase of 55 per cent. as compared with the stocks at the end of 1919.

The following table shows the amounts of new platinum and other metals of the platinum group that were recovered by refiners from gold bullion, nickel and copper in the United States in the years 1918—1920.

Year.	Platinum.	
	Troy oz.	Grams.
1915	6,495	202,017
1916	24,518	762,596
1917	33,009	1,026,695
1918	54,399	1,691,999
1919	40,220	1,250,983
1920	36,015	1,120,175

(a) Includes osmium.

Iridium, Osmiridium, Palladium, Rhodium,			
Troy oz.	Troy oz.	Troy oz.	Troy oz.
274	335	1,541	—
370	315	2,885	—
210	833	4,779	—
465	539	4,024	326
401	402	3,807	279
418	409	4,309	393(a)

Alaska.—It is reported that the gold placers of the Chistochina district (State Creek), in the south-eastern portion of Seward Peninsula, and also in some other districts, continued to produce small quantities of platinum in 1920.

The Salt Chuck mine (formerly the Good-roo mine), situated between Lake Ellen and the source of Salt Chuck creek, at the head of Kasaan Bay, Prince of Wales Island, Alaska, was originally operated for its low-grade copper deposit, but subsequently the platinum and palladium content were found to be more valuable than the copper, so that it is now termed a "palladium-copper mine." Work has been carried on there continuously since 1917, some 16 miners being employed in 1919. The deposit occurs in an area of coarse-grained intrusive pyroxenite rock, of the kind which invades the paleozoic sedimentary rocks of Kasaan Peninsula at many localities. The ore minerals consist of sulphides in grains and small patches in the pyroxenite. Bornite is the chief copper mineral, but a little chalcopyrite occurs locally. Both chalcocite and covellite are present, as alteration products of the bornite and chalcopyrite. Besides palladium, a little gold, silver and platinum is recovered. As partial tests

have shown the presence of somewhat more than 3 oz. of palladium to the ton of concentrate, and as a ton of concentrate represents about 28 tons of ore, there would be a palladium content of a little over one-tenth of an ounce to the ton of ore. The proportion of the palladium to the small amount of platinum in these deposits is estimated at about 50 to 1. Each ton of ore is figured to contain about 28.5 lb. of copper. At 12 or 13 cts. a lb. the copper would donly be worth from 3.40 to 3.70 dollars, while the 0.1 oz. of palladium might be valued at 12 or 13 dollars.

The company organised to exploit the platinum and palladium deposits of Kasaan Bay, Alaska, has a capitalisation of 150,000 shares issued at 10 dollars each. The company owns 29 full mining claims and 16 partial ones, and the statement is made that out of one-tenth part of a claim, opened up to a epth of 150 feet, ore worth 400,000 dollars has been secured. The material is sold to the smelting works in Irvington, N.J. In all, it is asserted that 200,000 tons of ore has been extracted, the net value of this being about 1,000,000 dollars. Should all expectations be realised, this Alaskan field would make quite a notable contribution to the world's production of platinum.

(To be Continued.)

THE VOLUMETRIC DETERMINATION OF TiO_2 IN BAUXITE.

By H. J. WINCH, A.C.G.I., F.I.C., AND
V. L. CHANDRATREYA, B.A., B.Sc. (Hons.),
(POONA).

Owing to dissatisfaction with the gravimetric methods, the following volumetric method was worked out in the Shivrajpur Mines Laboratory.

The method depends on the complete reduction of all Iron and Titanium Salts to the ferrous and titanous state by Tin in HCl solution, elimination of the excess of SnCl_2 by HgCl_2 , and finally the conversion by the titanous salt of an equivalent amount of ferric salt to ferrous state.

Titration gives a result for the Fe_2O_3 and TiO_2 present. The figure for TiO_2 is obtained by deduction of Fe_2O_3 estimated by a simple Fe determination.

0.3 Grm. of the dried ore is mixed in a platinum crucible with about 10 times its

weight of KHSO_4 , and gradually brought the crucible between the hands and transferred to a beaker, any portion remaining in the crucible being extracted with hot dilute HCl and added to the contents of the beaker. The bulk should be kept as low as possible.

Strong HCl is added, and the melt dissolved by boiling. The solution is transferred to a conical flask and 0.15 gram. of pure tin powder (free from Fe) with 5 grms. of NH_4Cl added.

The flask is loosely closed by a small funnel with a small watch glass upon it, and the contents gently boiled until all Sn is dissolved. It is sometimes necessary, if the solution proves too dilute, to add a further quantity of strong HCl to expedite the solution of the Sn .

When this is complete, cold recently boiled water is quickly added from the sides of the flask, and then 50 cc. of a solution of HgCl_2 of a strength of 40 grms. per litre, which quantity is sufficient to ensure complete elimination of the balance of SnCl_2 present.

into fusion until the melt is clear. It is kept fused for 15 minutes, and the crucible then tilted and allowed to cool. The contents are cracked out by gentle rolling of

The contents, which should be about 300 cc., are quickly agitated, and about 5 cc. added of a solution of Ferric Chloride (free from Ferrous Iron) of a strength equivalent to about 10 grms. of Fe per litre. The quantity added must be more than sufficient to convert all TiCl_3 to TiCl_4 . The solution is shaken and titrated against standard $\text{K}_2\text{Cr}_2\text{O}_7$ solution using potassium ferricyanide indicator drops on a porcelain plate until no blue colouration is obtained, as is usually done in the determination of Fe by $\text{K}_2\text{Cr}_2\text{O}_7$.

The result is calculated to the total Fe_2O_3 and TiO_2 present, the factor being the same for both. The time taken for this determination is 2-3 hours.

It may be noted that this titration may be made without the addition of FeCl_3 , but the advantages claimed for the addition are:—

(1) The indication of the end of the titration is much more sharply defined.

(2) The danger due to the rapid oxidation by atmospheric oxygen of titanous salts is avoided.

For the determination of Fe_2O_3 alone, a separate portion of 0.3 gram. is similarly

fused and dissolved, transferred to a Phillips beaker, evaporated to 50 cc. bulk, and a little NH_4Cl added, when the Fe is reduced in boiling solution by the addition of dilute SnCl_2 solution, drop by drop at the finish, until the yellow colour just disappears.

Cold boiled water is added up to about 300 cc., and the solution straightaway titrated against the same $\text{K}_2\text{Cr}_2\text{O}_7$ standard as before.

The difference between the two results calculated to Fe_2O_3 gives the quantity of TiO_2 present owing to the factor for each being the same.

This method has been extended with most satisfactory results to the analysis of rocks, clays and shales containing Titanium.

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A CENTURY OLD CHEMICAL DICTIONARY.

BY JAMES F. COUCH.

(Reprinted from the "*American Journal of Pharmacy*," January, 1922)

In a recent little volume Dr. Edgar F. Smith has described the lifework of one of the earliest of American chemists, James Cutbush. While the whole essay will prove of interest to the scientific reader, pharmacists will be especially interested in learning that Cutbush styled himself "chemist and apothecary," and that, in 1812, he advertised a course of lectures on "theoretical and practical pharmacy" probably delivered "at the Laboratory in Vidal's Court, in Second, near the Corner of Chestnut St.," in Philadelphia.

It is not my purpose to discuss the excellent contribution of Dr. Smith. That has already been most satisfactorily done by the pleasing pen of Dr. C. E. Munroe. But I wish to call attention to one of the many publications of Cutbush, perhaps not his most important contribution to American scientific literature, but one which serves the very useful purpose of a base from which to measure progress. In 1821, a century ago, Cutbush published his "A Synopsis of Chemistry, Arranged Alphabetically: comprehending the names, synonyma, and definitions, in that science."

This is a little book of 85 pages, 9 by 14 cm. in size, bound in boards, and it appeared at the time when the author was acting professor of chemistry and mineralogy in the United States Military Academy.

The chief interest of this work is that it presents a general view of the state of chemical knowledge just a century ago, and permits us to observe the advances and the changes which the past hundred years of intensive scientific activity have occasioned.

Much of the old involved nomenclature of early chemistry is present. We read of "hydriocyanic acid" (p. 30), and of "hydroxydates" (p. 31) yet, throughout the book, there is a minimum of this sort of terminology and the whole is clear, concise, and phrased in simple language. There is not a chemical formula in the entire text which is not surprising for the theories of valence were not yet formulated. We must remember that Kolbe was born in 1818, Frankland in 1825, and Kekulé in 1829.

James Cutbush, "An American Chemist," 1919.

Book Review, *J. Am. Chem. Soc.* 43, 1743 (1921).

Some of Cutbush's definitions can hardly be improved upon at the present day. Chemistry he defines (p. 17), "That science, which treats of the action of bodies on each other, and having, for its object, the discovery of their constituent principles, the results of the various combinations, and the laws by which these combinations are affected." Analysis is defined (p. 10), "The separation of a substance into its constituent parts." Carbonates (p. 15), "Salts formed by the combination of carbonic acid with a base." He possessed a clear idea of neutralisation, (p. 45), "When certain substances unite, and lose their individual properties, they are said to neutralise each other."

Cutbush, too, was up-to-date. He speaks of "molecules," of iodine, which had recently been discovered, of compounds (although he does not define this term), and says of "phlogiston" (p. 52), "An imaginary element. A constituent part, it was thought, of all inflammable bodies."

He includes notices of "morphia," "nicotin," and "strychnin." Of maceration he says (p. 37), "The process of

softening a substance, by steeping it in a fluid, without impregnating the latter." This is, of course, quite contrary to the modern meaning of the term. Rectification is (p. 63) "Distillation repeated as often as circumstances require."

The erroneous or primitive ideas prevalent at the time find expression in the definitions for latent heat (p. 36), "Heat chemically combined, not appreciable by the senses," oxydes (p. 49), "Combinations of oxygen with different bases, not possessing, strictly speaking, acid properties," and for affinity which may be "single," "double," or "disposing." Disposing affinity apparently is emulsification; double affinity is what we should now term double decomposition. Single affinity is defined (p. 7), "When two bodies are united and are separated by a third, single affinity is said to take place." Hydrogen peroxide is termed "peroxidised water" (p. 51) and fermentation (p. 24) is "A peculiar spontaneous process, which bodies undergo, when exposed to a proper degree of heat, and for a certain length of time." Nevertheless we suppose that the factitious blondes were as attractive and the brewed products as seductive then as at any time since.

Magniloquent titles are not lacking; bread making is "panification" (p. 51), the art of assaying metals is the "docimastic art" (p. 22), "eliquation" is the separation of substances by fusing out one of them. Sir Humphrey Davy is accused of fathering the terms "phosphorane" and "phosphorana" for the tri- and pentachlorides of phosphorus respectively (p. 52).

Boric acid is termed "narcotic acid" (p. 45) and "narcotic salt" (p. 6). While nitrogen is "mephitic gas" (p. 11), carbon dioxide is "mephitic acid" (p. 39). Carbonic acid is "calcareous acid" (p. 14), and the "acid of sugar" or "saccharine acid" is oxalic acid (p. 72) probably in reference to its production by heating sugars with nitric acid. Coagulation is defined (p. 18), "An operation by which fluids are made clear, by the use of serum and albumen, and the application of heat." "Butter of Arsenic" is arsenic pentachloride (p. 14) and "green fecula" is the term given chlorophyll (p. 24). A gas is (p. 27) "A combination of a base with caloric; as hydrogen and caloric, forming hydrogen gas." Elements (p. 23) are

first principles. Simple substances. Undecomposable substances." and effervescence is "the sudden escape of a gaseous substance, accompanied with an intestine motion," (p. 23).

As an instance of the medical superstition then prevalent, Cutbush's definition of "miasma" may be quoted. "Matter of contagion. Certain bodies are known to exist in the atmosphere, we will not say combined with it, which exert a powerful action on the human body, and which have been termed *matter of contagion*. Miasmata may proceed from the decomposition of vegetable, or of animal substances, and the atmosphere may be tainted by other causes. In all cases, however, it has been supposed that a certain noxious matter is dissolved in, or diffused through the air, and that by the action of this matter on the living body certain diseases are produced. When noxious effluvia arise from putrefaction, it is known that certain agents will destroy it; hence the vapor of nitric acid, of muriatic acid gas, and of oxymuriatic acid gas, or chlorine, have been used with great success, in disinfecting air." (p. 41).

From the foregoing one can appreciate the mists which clouded the conceptions of chemists a century since. Superstition, humbug, fallacy had to be removed, a science had to be organised and a simple practical system of notation had to be invented. Very little of our present chemical knowledge existed, and what there was appears ill-defined and co-ordinated. The tremendous importance of the contributions of such men as Berzelius, Liebig, Dumas, Gerhardt, Pasteur, Faraday, van't Hoff, and Fischer, with their contemporaries stands forth in *alto relievio* when we contrast the present year with hundredth predecessor.

Much of Cutbush's text is now only curious; some of it is rather absurd. We cannot help but hope, however, that since this sort of thing is one way of measuring progress, our successors in 2021 will find much of our present though ancient and perhaps a trifle ludicrous.

"FLUORINE."

THE MOST ACTIVE ELEMENT KNOWN.

By John Missenden, B.Sc.

Fluorine is an elementary substance closely allied to chlorine, it being the only

other gas belonging to the halogen group and possessing somewhat similar active properties.

In 1887, Moissan succeeded in isolating it to a certain extent by resorting to a process of electrolysis, the electrolyte being liquid hydrofluoric acid free from water, but with a slight addition of potassium hydrogen fluoride to render the liquid electrically conductive. The experiment was carried out in a platinum-iridium U-tube (the hydrofluoric acid, q.v., readily attacking glass), and the fluorine was set free at the anode, hydrogen being freed at the cathode.

The chief source of fluorine, for the purposes of commerce, is:—

Fluorspar (or *Fluorite*), a mineral which consists mainly of calcium fluoride, CaF_2 .

Physically, it is a crystalline substance which assumes the cubic system, very perfect and many coloured crystals being formed. These are commonly found in such localities as Illinois and Indiana in U.S.A., in the volcanic regions of Italy, and in Derbyshire and Cornwall. It is generally associated with the ores of lead, tin, copper and silver. Mostly, it occurs in veins, but it is also found in some of the dusty cavities in granite as well as in veins in limestone, sandstone, slate and crystalline schists. In the Derbyshire mines, where it is known to the miners as "Blue John," it is a common practice to make ornaments out of fluorspar—so massive are the crystals—so that it is often called by the alternative name of Derbyshire spar.

As well as containing fluoride, it sometimes contains small quantities of calcium chloride, CaCl_2 , and, less frequently, some organic matter which occasionally becomes so abundant as to emit a fetid odour—hence the name *fetid-spar* (stench-fluss: Ger.)

Other sources of fluorine may be mentioned in *cryolite*, sodium aluminium fluoride (Na_3AlF_6), and a few other minerals such as the igneous rocks, natural waters, and certain animal tissue (bones, teeth, blood and milk), but it is only present in minute quantities in these substances while it is present in fluorspar to the extent of 51.18 per cent.

It has a very powerful action upon such substances as glass, gold and platinum, consequently any attempts to isolate it in vessels made of these metals is futile. The only material that can more or less withstand its action must be composed of an alloy of platinum and iridium in fixed proportions, and it was a vessel of this description that was used by Moissan.

In appearance, fluorine is a pale yellow gas, and is possessed of an extremely irritating odour. At -187°C . it may be liquified, and still retains its yellow tint. It can be solidified at -223°C . Chemically, it is the most active elementary substance known. It decomposes water readily, liberating ozone O_3 . With such substances as hydrogen, carbon and silicon it unites with such violence as to generate great heat, causing an inflammatory union. Also, it combines with iodine and bromine, two other elements of the halogen group, to form fluoric iodide and fluoric bromide. Such substances as phosphorus, arsenic and sulphur offer themselves for ready combination; while it will attack magnesium, sodium, potassium, mercury and other metals. Indeed, the only elements that it does not have any visible effect upon are oxygen, nitrogen and chlorine.

Hydrofluoric acid (or *hydrogen fluoride*), HF , is the acid analagous to hydrochloric acid, but it is far more active.

It is generally prepared by heating in a lead still a mixture of two parts of sulphuric acid with one part of fluorspar, the following action taking place:—

$$\begin{array}{l} \text{CaF}_2 \quad + \quad \text{H}_2\text{SO}_4 \\ (\text{fluorspar}) \quad (\text{hyd. sulphate}) \\ 2\text{HF} \quad + \quad \text{CaSO}_4 \\ = (\text{hyd. fluoride}) \quad (\text{calc. sulphate}), \end{array}$$

the two molecules of hydrofluoric acid being driven off and conducted to a freezing apparatus by means of lead pipes, leaving the calcium sulphate and the other part of the sulphuric acid—which has acted as a catalyst—in the still.

When prepared in its most concentrated form, hydrofluoric acid has a density of 1.06, and is a colourless fuming liquid, highly volatile and with a boiling point of 15.5°C .

Its most useful property is demonstrated by its action on glass. It attacks the silica contained therein, and thus may be used for etching on that substance.

Fluorsilicic acid, H_2SiF_6 , is obtained by the decomposition of silicon fluoroform by

water or alcohol. It is not commercially important.

Fluortype. This expression will be familiar to photographers who have a preference for the softer form of negative. The process consists of coating a plate to be exposed with a fluoride solution which, afterwards being developed, has to be intensified with a solution of ferrous sulphate, $\text{FeSO}_4 \cdot 5\text{H}_2\text{O}$, and fixed with the usual mixture of sodium hyposulphite and water. The process was first introduced in 1844.

CHEMICAL NOTICES FROM FOREIGN SOURCES

CATALYTIC DECOMPOSITION OF SHARKS' OIL—*Alphonse Mailhe*.—When sharks' oil is subjected to decomposition and hydrogenation, it behaves in exactly the same way as the vegetable oils, linseed and colza. When the vapour is passed over a catalyst composed of aluminium and copper mixed and heated to 600° – 650° , liquid and gaseous products are formed. The latter, when freed from acrolein, consist chiefly of hydrogen and hydrocarbons. The former are treated with dilute soda to neutralise the acids, and then a strong smelling yellow liquid is obtained which can be hydrogenated over divided nickel at 180° – 200° . Thus a colourless product with an agreeable smell is obtained, which gives a straw coloured colouration with sulphuric acid. It can be separated into various portions by fractionation, and those obtained between 70° and 150° contain aliphatic, aromatic and cyclo-aliphatic hydrocarbons, the last predominating. The portion distilling over between 135° and 140° contains metaxylene, meta-hexahydroxylene and aliphatic hydrocarbons. Above 150° each fraction consists of hydrocarbons, most of which are attacked by a sulpho-nitric mixture. The acid products obtained by the decomposition of sharks' oil include unsaturated acids which on hydrogenation give cenanthylic acid, petargonic acid, and lauric acid, besides possibly other lower acids. Acetic acid has not been identified among the products.—(*Bull. Soc. Chim.* XXXI.-XXXII., 1922, No. 3.)

UNION OF CHLORINE AND HYDROGEN WITHOUT EXPLOSION IN PRESENCE OF CONTACT SUBSTANCES *B. Neumann*. Calcium, aluminium and magnesium chlorides, after

having been heated to 400° in a current of the gases chlorine and hydrogen, bring about the quantitative union of these gases at 300° to 380° , provided that the rate of the current of gases is not too rapid. Magnesium and calcium chlorides are partly (6 to 8 per cent.) converted into MgOHCl and CaOHCl , while aluminium chloride is almost entirely transformed into Al_2O_3 . Quartz can also be used as a contact substance, the temperature of the reaction being 380° . It is absolutely necessary to have enough water present in the mixture of gases so that finally $\text{HCl} + \text{H}_2\text{O}$ may be obtained. Air has no effect upon the reaction, since the temperature is too low for the oxygen to oxidise the hydrochloric acid.—(*Zeit. f. Angew. Chem.*, XXXIV., 1921.)

STASITE, A NEW MINERAL.—*Alfred Schoep*.—Chalcolite obtained from Kasolo (Katanga, Belgian Congo) frequently contains a new mineral, which appears yellow to the naked eye, of density 5.03 at 17°C . Chemically this new substance behaves like dewindtite. When heated in a closed tube it gives off water, and becomes reddish brown, returning to its original colour when cooled. When heated on charcoal in the oxidising flame of the blowpipe, it readily fuses to a black globule, while when heated with sodium carbonate in the reducing flame it gives globules of lead. It dissolves in nitric acid, and the solution gives with molybdic liquid a copious yellow precipitate of ammonium phospho-molybdate. The mineral also dissolves in hydrochloric acid with formation of crystals of lead chloride and in sulphuric acid, giving a precipitate of lead sulphate; these solutions are coloured yellow by uranium. When the mineral is analysed, it is found that its composition corresponds to the formula $4\text{PbO} \cdot 8\text{UO}_3 \cdot 3\text{P}_2\text{O}_5 \cdot 12\text{H}_2\text{O}$, which is the same as that of dewindtite. It differs from the latter in density, colour, the colour of its dust, and its crystalline form. Its radioactivity is slightly less than that of dewindtite. Stasite, the new mineral, and dewindtite are two dimorphous varieties of the same compound.—(*Comptes Rendus*, CLXXIV., No. 13, 1922.)

CATALYTIC DECOMPOSITION OF OLEIC ACID.—*Alphonse Mailhe*.—When vapours of oleic acid are led over copper-aluminium heated in a copper tube to 500° – 650° they decompose normally, giving liquid products, water and gas. The latter consists

chiefly of hydrocarbons of formula $\text{C}_n\text{H}_{2n+2}$ and hydrogen, and contains also CH_4 , CO , $\text{C}_n\text{H}_{2n+2}$ and CO_2 . The liquid products are acid. When they are treated with dilute soda a yellow product is obtained which begins to distil at 40° . The different fractions get hot when treated with sulphuric acid, which absorbs more than half the liquid. The portion distilling between 40° and 50° gives with bromine amylene dibromide. When the liquid obtained by the decomposition of oleic acid is hydrogenated over nickel, it is transformed into a mixture of aliphatic hydrocarbons and cyclic hydrocarbons, amongst which are benzene, toluene and metaxylene.—(*Comptes Rendus*, CLXXIV., 13, 1922.)

PROCEEDINGS AND NOTICES OF SOCIETIES.

“THE POSSIBLE ECONOMIC DEVELOPMENT OF HOME SUPPLIES OF FUEL OIL.”

BY PROF. J. S. S. BRAME, F.I.C.

(*President of the Institution of Petroleum Technologists*).

The usual monthly meeting of the Section was then held, and Prof. Brame read the above-titled paper.

Prof. Brame, in dealing with the necessity for this country to take into serious consideration the possibility of the development of the home supply of fuel oil, reviewed the published proceedings and findings of the “Crewe” Committee and the Department of Petroleum Research at some length.

Early in 1918, the Institution of Petroleum Technologists appointed a Committee of Inquiry, the terms of reference to which were to obtain evidence in respect of the quantity of cannel coal available in Great Britain as the source of motor spirit, fuel oil, etc., and to formulate a scheme for the utilisation of such supplies. In their conclusions, this Committee stated that the possibility of obtaining oil in quantity from the low temperature distillation of cannel coal and its cognates had been considered from two points of view, namely, as an immediate war measure in respect to mak-

ing provision for the Services, and as a commercial undertaking and measure of reconstruction. Further, the Committee were satisfied that at least 1,200 tons per day of retortable material could be economically assembled for treatment, provided the necessary facilities were given by the Government, and the requisite labour was available, at an average of 30 gallons of oil per ton, thus giving a yield of 300,000 gallons of crude oil daily, or upwards of 400,000 tons a year. Much of the material available had hitherto been mined but not raised, or, if raised, had been consigned to spoil heaps or returned to the underground workings. If the substitution of the shovel for the fork, so strongly demanded by the miners, was made obligatory by the Government, still more material would be sent up, and, under present practice, wasted. An improvement in this state of affairs necessarily depended upon the obtaining of by-products. The residues obtained from a non-caking material high in ash content could be utilised in a producer for the production of power gas and sulphate of ammonia. The residue obtained from a non-caking coal low in ash content could be utilised for the manufacture of briquettes.

The conditions which existed in wartime, and which probably justified the small attempt made in this country to produce fuel oil, did not exist to-day. The difficulty then was shortage of labour. The problem to-day was shortage of work. Any scheme which appeared to promise a possibility of providing labour for the unemployed, and at the same time be the means of producing valuable and easily marketable commodities like liquid and smokeless fuels, was worthy of serious consideration. In view of the large power stations which it was proposed should be installed throughout the country in the immediate future, the question of the utilisation of retorted residues for power production became of increased importance.

The world's demand for fuel oil had gone up by leaps and bounds during the past five years. There had been a certain proportionate increase in production, and the Persian Oil Company had now established refineries at Swansea, while another company had established others at Southampton. In 1920 the output of oil was about 97 million tons. There was an importation of four million gallons of crude oil, motor spirit 207

million imperial gallons, lamp oils 161 million gallons, lubricating oils 106 million gallons, gas oil $53\frac{1}{2}$ million gallons, fuel oils 327,771,000 gallons. On the basis of the recommendations of the Committee of Inquiry of the Institution of Petroleum Technologists, 100 million gallons of crude oil could be produced per annum. It must be borne in mind, however, that this oil was not quite the same thing as crude petroleum. A considerable proportion of it would not be suitable for use as fuel oil, as it contained pitch, which would have to be left behind by distillation. Possibly 60 per cent. of the total oil obtained would be suitable as liquid fuel. Another drawback in the case of oils obtained by low temperature distillation was that they were somewhat rich in tar acids, thus detracting considerably from their calorific value. It would not pay to separate out tar acids. Another point was that the oils became a butter-like mass owing to the presence of wax. They, therefore, required cracking.

Prof. Brame then dealt briefly with the position of the Scottish Shale Oil Industry, and mentioned the shale deposits which outcropped in Dorset and Norfolk. In the case of the two latter there was a high sulphur content of from 7 to 8 per cent., which it was extremely difficult to eliminate by chemical treatment.

Dealing with low temperature carbonisation of coal, Prof. Brame referred to the Report of the Nitrogen Products Committee issued in 1918. This Committee pointed out that if the whole of the 35 million tons of domestic coal consumed in this country were substituted by low temperature coke, it would mean that 54 million tons of coal would have to be carbonised. The yield of tar, at 18 gallons per ton, would be 972 million gallons, and of light spirit, counting 2.25 gallons to the ton, would be 121.5 million gallons. He fully believed that the commercial unit for carbonisation at low temperatures had been arrived at in more than one instance. The idea of carbonising coal with the object of obtaining a smokeless fuel was not new; it was discussed as long ago as 1656.

Having indicated the main points of patents taken out for the production of smokeless fuel down to the time of Thomas Parker (1890), the lecturer explained the construction and method of operation of the "Tozer" Patent Retort, the "Chis-

wick" Screw Retort, the "Smith" Plant, and the "L.M.N." System.

The Nitrogen Products Committee stated that there was no *comparative* practice in this country upon which definite reliable data could be formulated as to costs and average yields, though they published some extremely valuable information relating to low temperature carbonisation with subsequent gasification of coke. The figures given, however, must be accepted with a certain amount of reserve, as the results indicated were those of only two systems, the "Tower" and the "Chiswick." If a large power plant was taken, such as would be supplied for a station generating 100,000 kw., with a 100 per cent. load factor and an average coke, and the over-all efficiency of a steam plant with direct firing and turbines taken as 100, then the efficiency of low temperature carbonisation was somewhere between 72 and 75 per cent., but if one took the coke, and subsequently gasified it, and used the gas at 75 per cent. efficiency for raising steam in the boilers, then the efficiency only ran from about 40 to 45 per cent. Taking the question of the ratio of coal consumption, direct coal fire being taken as unit, low temperature carbonisation, followed by the use of coal under the boilers, would require 1.32 to 1.39 lbs. of coal instead of 1.0, and if the coke residue was utilised it would require 2.2 to 2.5 times.

Although there was probably very little Torbanite in this country yet, it contained material which was very rich in oil. Bastard cannels were usually high in ash content, but they were undoubtedly retortable material. Mr. Dunningham Craig considered that there were very few of the remaining cannels which would yield 50 gallons of oil to the ton, but many of them would yield 40. The worst of the bastard cannels would yield something between 20 and 25 gallons, and whether it would pay to retort them depended largely upon the utilisation of the gas which might be obtained from the carbonaceous material left in the residue. A considerable quantity of sulphate of ammonia could be obtained by means of low temperature carbonisation, but of course the bulk of the nitrogen remained in the carbonised residue, and a considerable amount of revenue might be derived from subsequent gasification. There was also a possibility of saving a lot of good coal by means of working, if the "floor," for instance, was capable of distillation after cutting.

There was a considerable difference between low temperature tar and high temperature tar. One might almost say that the low temperature tar was a kind of intermediate body between petroleum and high temperature tar. It contained a comparatively large quantity of saturated hydrocarbons and a comparatively small quantity of the benzinoid hydrocarbons, and very little free carbon. It did not contain naphthalene, though it did contain a large quantity of tar acids which might prove to be a drawback in the use of the oil in internal combustion engines. Steam raising by oil was really unpardonable, except under such circumstances as existed in the navy.

If the oils were used in a raw state, one did not know what the effect of the 30 to 40 per cent. of pitch material might be, but it would probably be the same as a high asphalt content in a mineral oil. It was easy enough to wash out the acids. American scientists had shown that if coal was distilled under high pressures, with a reflux arrangement fitted to the retort, there was condensation of the higher boiling fractions and dropping down into the retort, and there could be cracking of a larger quantity of the phenolic bodies into lighter spirits. Cannel oils were a different type of material to that obtained from the low temperature tars. The coke from bituminous material was not the same as from cannel and canneloid substances, owing to the presence of paraffin wax. It was a doubtful proposition whether it would pay to extract the paraffin wax, and it had the great disadvantage of establishing a high setting point which might be 30 deg. C.

Low temperature oils sometimes held water in a most persistent way, and in some cases it appeared to be in a perfect state of solution.

A long discussion followed the reading of the paper, and the proceedings concluded with a vote of thanks to Prof. Brame.

THE SOCIETY OF DYERS AND COLOURISTS.

ANNUAL MEETING.

The annual gathering of the Society of Dyers and Colourists took place in Manchester on March 31, and the preliminary proceedings were opened at the College of

Technology. Prof. E. Knecht, Ph.D., M.Sc., presided over a very large meeting.

THE ARTIFICIAL SILK INDUSTRY.

Prof. E. Bronnert, Ph.D., of Strasbourg and Mulhouse, Alsace, France, who is a manufacturer of very large quantities of artificial silk, gave an extremely interesting and instructive address upon the progress made in the artificial silk industry.

Prof. Bronnert said that the history of the artificial silk industry, that is to say the various processes by which it has evolved, is too well known to require further detailed repetition, but perhaps a short resumé, by way of introduction, would not be considered out of place.

The idea of producing practically artificial fibres which might perhaps some day supplant those of the silk worm, is due to Count Hilaire de Chardonnet, who has been called the father of the artificial silk industry. To him we owe the nitro-cellulose process which he published in 1884. This process was the first to be used on an industrial scale, and was prevalent throughout the nineties. The close of the nineteenth century saw the industrial adoption of the cuprammonium process by Bronnert, Fremery, and Urban. Following hard upon these two processes are those of the Viscose and more recently the Viscose improved processes.

The use of artificial silk may be said to be as yet in its infancy, and from day to day fresh uses are discovered for its products. They tend to increase as cheaper processes are evolved. The silk as it was originally manufactured, owing to this factor of cost, has only been able to be used to advantage along with other textile fibres, such as cotton, and in these cases the fibre preponderating has not been artificial silk. It is only now that artificial silk alone is being used in the manufacture of articles on a large scale. The present fashion has been of much use to the industry, for it has been possible to use the silk in the manufacture of ties, jumpers, stockings, underclothing, and articles of a similar nature, without the admixture of other fibres.

A new step has been taken in the production of artificial viscose silk. Until now, artificial silk, for a variety of reasons, has only been produced of a count varying from 8 to 10 deniers, while the double thread of the silk worm is of two to three deniers. It has always been a complaint among con-

sumers of artificial silk thread that manufacturers appeared to be unable to place a thread of the fineness of natural silk on the market. A French inventor and artificial silk manufacturer has now supplied this need in a most remarkable manner.

Colloidal solutions of cellulose, like viscose, are spun by the well-known process of forcing them through fine apertures. The apertures were required to be smaller in the case of a fine thread, and larger in the case of a coarse thread. More concentrated solutions of cellulose were required to obtain stronger threads. Concentrated solutions of cellulose, on the other hand, required narrower openings because of their high content of cellulose. However, the difficulty in filtering the solutions in order to prevent a rapid choking and the boring of the apertures, as well as the increased pressure required, are all causes of an irregular spinning, and operated therefore against a higher concentration. Hitherto an average good spinning of 8 deniers has been accomplished, with a solution containing 8 per cent. of cellulose, and with apertures of 0.1 mm. diameter.

The employment of finer apertures occasioned only more difficulties, and among other attempts, one of drawing off rapidly the thread as it was produced and of a less feed of viscose to the nozzles, proved quite unsuccessful. Many were the attempts made to solve this problem of the fine thread.

Now, however, it has been shown that under certain conditions threads of two to three deniers and less may be spun with the greatest regularity and ease. The same size of apertures may still be used, and the same maximum spinning speed of 45 metres per minute may be continued. The two factors of this important improvement are the feed of viscose to each aperture in relation to a unit of time, and a minimum percentage of acid different for each count is necessary in the spinning bath. Below this minimum, spinning of this count is impossible. It is a well-known fact that a rapid exhaustion of the acid spinning bath took place in the case of the former 8 deniers threads, when the flow of the alkaline viscose running through an acid bath had neutralised the acid to a greater or less degree. But until now it has not been known that for each count a special and strictly limited minimum concentration was required, in conjunction with an ap-

propriate feed, and that it was possible to retain the usual nozzle of 0.1 mm. by using, for example, the ordinary viscose as usual by ripening the alkaline cellulose first and then the viscose solution itself to a certain degree of maturity.

In this new process for fine spinning, maintaining the minimum concentration for each count is so important that no lower count can be spun with regularity than that of the particular thread for which it is adapted.

There is a certain relation between the counts of the single thread and the concentration of the acid in the spinning bath, and this has been reduced to a rule and named by Prof. Bronnert the "Square Root Law." The square roots of the different counts are inversely proportional to the concentration of the acid in the bath. The minimum concentration for an 8 deniers thread is, as already known, 140 gms. of monohydrated sulphuric acid per litre. For this new spinning process no change need be made in machinery, and the output remains unaltered, and any count may be spun with the apparatus by the mere conforming of conditions according to the square root law.

Brilliance in the fine counts may be varied at will and without any damage to the strength of them. To reduce brilliancy and to obtain an opaque thread, it is only necessary to lower temperature, whereas by raising the temperature to 40 or 50 degrees C., a thread of more and more brilliancy is produced. The new viscose has a very soft touch and a much increased covering power, dyes evenly, and when woven does not easily crease.

Methods have been put forward for the recovery of the products in the viscose process. In the cuprammonium process a recovery of about 90 per cent. of the ammonia and 95 per cent. of the copper has been effected without excessive expense. The soda lye in the viscose until now had been wasted, after having been neutralised by the sulphuric acid of the spinning bath. It had been suggested to recover sulphate of sodium from the spinning bath by cooling it, and so causing a dissociation of the bisulphate in the spinning bath into neutral sulphate and sulphuric acid. This method, however, was faulty and most expensive. The fact is that the sulphates produced do not remain in the spinning bath, but are formed only

on the threads emerging from it and received on the spools or the like. Threads, as a rule, are only slightly acid when the acid has penetrated the thread and entirely neutralised the alkali of the viscose. In washing with water the process of removing the neutral salt from the inner parts of the threads takes a long time, and much water is required.

The finer threads require a more acid salt bath, and acid and salt have to be added continually. In a new Bronnert process water acidulated with sulphuric acid is employed to such an extent that all sulphate in the threads is converted into the easily soluble bisulphate, which may easily be washed out on the addition of more sulphuric acid.

After using the same restricted quantity of acidulated water twice, an equilibrium is produced between the contents of bisulphate in the threads and that in the liquid. A further washing would not extract more of the salt, and so the threads are squeezed out and the liquid falling from them collected. After concentration to a certain degree the hot strong acid by sulphate of soda is added again to the spinning bath, instead of adding fresh sulphuric acid and neutral sulphate or bisulphate as was formerly done.

This process has proved most economical and gives the best result, when mixed ammonium and sodium salts are used together with the spinning bath.

A spinning bath of pure acid yields threads with an irregular round cross section. The same occurs when acid is in excess over salt in the spinning bath. The section differs completely when the salt is in excess, and produces the form of a star with serrated outlines. If the salt is in great excess, the thread appears to be coagulated more slowly, and takes the form of a bean, the serrated outline being nevertheless maintained. It is caused by a shrinkage which forces the water out of the inner parts of the thread into the surrounding salt solution. It is possible to observe from these characteristic forms which process has been used in the spinning, and it is as well most important for the specific lustre of the thread. The angular bulbs act like prisms to the light and increase or decrease the transparency of the threads. A higher temperature of the spinning bath hastens the plasmolytic process, shrinkage

takes place in a different way, and different effects are produced.

In spinning from ammonium salt with a little acid, threads are produced of a perfect round circumference, and although these may have a slightly less covering power, they are of even transparency and brilliancy, and of the highest tensile strength, which makes them suitable for use in braids and the like.

A great variation has been found in the strengths of even first class artificial silks, especially when dry. This may be caused by the irregularity of the cross sections and to a defective spinning, and may be brought about in the following way. It has been found that the apertures become choked not only when impurities owing to bad filtering are in suspension in the viscose, but also when the minimum concentration necessary for the special counts does not exist at each aperture. This becomes worse when some of the apertures are choked, the other apertures producing coarser threads owing to the additional feed of viscose. It is most important, therefore, to have the bath circulating and of constant composition and temperature. In the best silk resulting from one kind of viscose, when all the spinning factors are carefully arranged, the filaments all show the same even section. This may be realised in the acid wet spinning process with the greatest ease, and better than in the Chardonnet process when spinning collodion direct into hot air.

The short fibre received fresh impulse by the above described improvements of Prof. Bronnert. It may be spun to any count, and when it is fine may be mixed with chappe to a certain degree, or may be spun alone with a yarn resembling chappe yarn. These yarns at the same weight naturally exhibit a greater volume than the hanks of artificial silk yarn even when they are of the same count. Although the lustre partly disappears during the combing operation articles manufactured from the new mixed or unmixed yarns have a remarkable "feel" and brightness and if possible to be produced at a low price and on a large scale they may prove of great assistance to the textile industry.

Processes have been further cheapened by another Bronnert process. It is a well-

known fact that the usual way of drying gelatinous freshly precipitated and washed cellulose threads had to be carried on with extreme care. When the threads were placed too near to the steam pipes or radiators, producing the higher temperature, the threads became brown, and the cellulose was altered, which meant that only relatively low temperatures could be employed, and of course the drying process took much longer. Much room is required, and the cost for fuel is excessive. Until now the drying temperatures employed scarcely exceeded 60 degrees C.

It has been suggested to remove the water which was supposed to be chemically combined with the cellulose by steaming the threads, but this was a very tedious process. It has now been pointed out that the same gelatinous threads, when well washed from the salts and from the acid, may be exposed to hot air up to 110 degrees C., without becoming brown or producing an unevenness in dyeing afterwards, provided that care is taken that the air circulating at any place in the drying chamber maintains an equal velocity so that no warmer or cooler parts, caused by the evaporating water, exist in any section of the drying chamber.

It makes no difference if the temperature is not the same from one cross section to another, which may quite easily happen when the hot air becomes more and more saturated with water, and consequently cooled, but it is the usual practice to keep the air at the same temperature as when admitted, by reheating it from time to time in its passage through the drying apparatus.

The escaping air at the end of the process is practically at the same temperature at which it entered, and contains the maximum amount of water which is compatible for complete drying. It must be obvious to anyone knowing the great dissolving power of air, which becomes the more so with an increasing temperature, what a great economy of fuel must take place when less air at a higher temperature requires heating for a relatively short time in the drying process.

These improvements are of special significance for short fibre, which must be produced at a low cost on a very large scale if a constant market is to be created.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

The next Meeting of the Society will be held on Wednesday, May 3rd, at the Chemical Society's Rooms, Burlington House, Piccadilly, W., at 8 p.m.

The following Papers will be read:—

"Studies in the Titration of Acids and Bases," by J. L. Lizius, B.Sc., A.I.C., and Norman Evers, B.Sc., F.I.C.

"Graphites and other Pencil Pigments," by C. Ainsworth Mitchell, M.A., F.I.C.

"The Sulphuric Acid Reaction for Liver Oils and its Significance," by J. C. Drummond, D.Sc., F.I.C.

"Inadequacy of 'A.R.' Test for Alkalies in Calcium Carbonate," by W. Singleton and H. Williams.

GENERAL NOTES

OPPAU EXPLOSION.

The greatest explosion in history occurred on the 21st September, 1921, at the works of the "Badische Anilin und Soda Fabrik," at Oppau, near Mannheim, Germany. The reports, so far to hand, show that the explosion occurred at 7.30 a.m., and the casualties were given as 600 killed, and from 400 to 500 injured. The crater formed by the explosion was 135 metres in diameter, and 35 metres deep. The explosion took place in a silo containing 4,500 tons of a double salt of ammonium nitrate and ammonium sulphate. This sets hard at the bottom of the silo, and it was the practice to blast it out, using an ammonium-nitrate explosive and detonators. Although this had been going on for a considerable period and many thousand shots had been fired without accident, it has been suggested that this was the cause of the explosion.

THE STRUCTURE OF THE ATOM.

Under the above title, D. Stephen Maill, B.Sc., LL.D., has produced an interesting little booklet dealing in an original manner with the progress of events that have led up to our present conception of Atomic Structure.

The "story," for that, more than anything else, is the character of the brochure, commences with the discovery of the inert gases in the atmosphere, and gives details of the early work of Lord Rayleigh and Ramsay. The discovery of X-rays, Becquerel's discovery of the radioactivity of

Uranium, and the subsequent work of professor and Madame Curie; the work of Rutherford, Soddy, Moseley, Bragg, Langmuir, and others—is given briefly and with great accuracy.

The whole brochure is an exceedingly readable little production, and we can confidently recommend its wide distribution.

Publishers: Messrs. Benn Bros., 8, Bouverie Street E.C.4; price 1/6.

THE ATOMIC WEIGHT OF YTTRIUM.

An account is given in the Journal of the American Chemical Society of an exhaustive research by H. C. Fogg and C. James, to determine the atomic weight of Yttrium, the mean of twenty-one experiments gives 89.03. Clèves value was 89.12, and many other workers have found values not far removed from this.

OPIUM CULTIVATION.

In the House of Commons last week, Earl Winterton, the Under-Secretary for India, informed Mr. Gilbert that the area under poppy cultivation in British India was 177,124 acres in 1918-1919; 163,125 acres in 1919-1920; and was estimated at 143,750 acres for the year 1920-1921. The area under cultivation in the Indian States had been estimated at 24,871 acres in 1918-1919, and 56,934 in 1919-1920. In neither case were total figures available for any later period. The total amount of raw opium produced from the area under cultivation in British India was 2,247,061 lbs. in 1918-1919; 1,876,114 lbs. in 1919-1920; and was estimated at 1,645,714 lbs. in 1920-1921. No information was available regarding the total production of the Indian States. The amount of raw opium exported from British India was 14,828 chests in 1918-1919, and 10,509 in 1919-1920. The gross revenue derived by the Central Government from opium was £3,289,111 in 1918-1919; £3,037,480 in 1919-1920; and was estimated at £2,415,466 in 1920-1921.

IMPORTATION OF DYESTUFFS.

Mr. Kiley asked the President of the Board of Trade if his attention had been called to the resolution passed at a meeting of chemical merchants and users, at a meeting in London on 4th April, affirming that the Dyestuffs (Import Regulation) Act and the Safeguarding of Industries Act had

not only failed to achieve the results the promoters anticipated, but had caused grievous inconvenience, great uncertainty, vexatious delays, and much loss of time, money, and prestige, and, as the continuance of these Acts threatened to jeopardise and divert trade vital to national interests and increase rather than lessen unemployment, the early repeal of both Acts was demanded; and, if so, what action he proposed to take.

Mr. Baldwin said: I understand that a resolution to the effect stated by the hon. member was recently passed by a body called the Chemical Merchants' and Users' National Vigilance Committee, but as I do not accept any of the propositions laid down in the resolution, I do not propose to take any action in the matter.

Mr. Lyle-Samuel asked the President of the Board of Trade what was the total value of reparation dyes received from the Germans during the year 1920-21 and the value realised; whether all these dyes were sold through the medium of the central importing agency; and what was the amount of commission and expenses allowed to this organisation.

Mr. Baldwin replied: I am unable to state separately the value of Reparation Dyes received from the Germans during the year 1920-21, but the total value of Reparation Dyes received from Dec., 1919, to March 31, 1921, was £549,094, and the amount realised from sales during that period was £380,062. The dyes were all sold through the Central Importing Agency, who were paid a commission, to include expenses, of 3½ per cent. on the amount realised.

NOTES ON BOOKS.

Elementary Chemical Microscopy, by EMILE MONNIN CHAMOT, B.Sc., Ph.D. Second Edition, partly re-written and enlarged. John Wiley & Sons, New York. Chapman & Hall, Ltd., 11, Henrietta St., Covent Garden, London. Price 25/- net.

The author states in his preface that in the six years which have elapsed since the appearance of the first edition, the great majority of American chemists have come to regard the microscope as a necessary adjunct to the laboratory.

The first eight chapters are chiefly occupied with the microscope and its acces-

sories, and Chapter 8 commences a course of practical work in quantitative analysis, determinations, melting points, refractive index, and other important matters. Throughout the whole work details are given of special experiments to be carried out by the student, making the work—as the author suggests in his preface—a textbook rather than a book of reference.

The value of a microscope as a means of investigation is becoming recognised rapidly as an aid in research not only in the chemical but in almost all other industries. The work in question will be found of real value in the research laboratory, as it deals with all the latest developments in the science of microscopy. The book is very fully illustrated, and is intended to serve as an introduction to the microscope and its accessories regarded as tools to work with.

A promise is given of a handbook of microscopic qualitative analysis, designed for the use of advanced students and professional chemists, which is in preparation. To those who have mastered the contents of the book under notice, such a work will be found of great value.

DEPARTMENT OF OVERSEAS TRADE.

22nd April, 1922.

His Majesty's Consul-General at New Orleans (Major C. Braithwaite Wallis) reports that an American firm of wholesale druggists are desirous of purchasing the undermentioned materials in the United Kingdom:—

- 500 barrels naphthaline balls and flakes.
- 5 bales Tinne Velly senna.
- 5 casks potassium permanganate.
- 1 cask sugar of lead acetate crystal.
- 1 cask potassium prussiate yellow.
- 5,000 lbs. acid carbolic white crystals.
- 1 lb. bottles and 5 lb. tins inclusive.

Quotations should include c.i.f. New Orleans, privilege of examination and cash against documents.

The name and address of the firm referred to may be obtained by United Kingdom manufacturers and exporters interested on application to this Department.



New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 9060 Adam, E. B. Production of red basic dye-stuffs. March 29.
9316 Colman, H. G. Treatment of hydrocarbons. March 31st.
9189 Law, H. D. Formaldehyde-producing apparatus. March 30.
9323 Schmidt, A. Chlorination of cellulose lyes. March 31.
9396 Techno-Chemical Laboratories, Ltd. Continuous filtering apparatus. March 31.

Specifications Published this Week.

- 176834 Woodhill, Duckham & Jones (1920), Ltd., and Sir A. M. Duckham. Furnaces for producing chemical changes.
153917 Merck, E. (firm of), and Wolfes, O. Preparation of tropinone monocarboxylic acid esters.
176864 Thermal Industrial and Chemical (T.I.C.) Research Co., Ltd. and Morgan, J. S. Method and apparatus for producing chemical reactions by action of heat.
176924 Shimadzu, G. Lead oxides and the process to manufacture the same.
176925 Sogahon, D., Pearson, D. H., and British Dyestuffs Corporation, Ltd.—Manufacture of oxy and sulpho-oxy derivatives of anthraquinone.
156215 Chemische Fabriken Worms Akt-Ges.—Manufacture of anthraquinone and its derivatives.

Abstract Published this Week.

Aluminium chloride. Patent No. 175,006.—A process of producing aluminium chloride has been invented by Mr. E. R. Wolcott, of 917, Chestnut Boulevard, Los Angeles, California, U.S.A. A mixture containing aluminium silicate and carbonaceous material is heated to drive off hydrocarbons, and is then further heated in the presence of a chloridizing-agent to distil off the aluminium chloride. Preferably, a naturally occurring mixture such as ore or bituminous shale or low-grade slaty coal is used, but the desired mixture may be made by grinding argillaceous material with low-grade petroleum, retroleum residues, peat, &c. The fuel-residue from any furnace which does not effect the complete combustion of the carbon with the addition of carbonaceous material, shale, &c., to make the mixture of the right composition may also be employed.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on request free the official notice of 1s. each.

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Mile End, E.1.

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

PHENOL PRODUCTS.

THE PROPRIETOR of British Letters Patent No. 9291, of 1914, is prepared to sell the Patent or to license British Manufacturers to work under it. It relates to an improved method of manufacturing condensation products of phenol and substances containing the methylene radical.

Address:— B. W. & T.,

111 & 112, Hatton Garden,

London, E.C.1.

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3238.

THE BRITISH GLASS INDUSTRY.

On the retirement of Dr. Morris Travers, F.R.S., from the Presidency of the Society of Glass Technology, Professor W. E. S. Turner, D.Sc., of Sheffield University, was unanimously elected for the ensuing year.

In his presidential address, entitled "The British Glass Industry: its Development and Outlook," Prof. Turner outlined some of the work he hoped the Council would be able to do during the forthcoming year, and included in his survey the revising and re-issuing of standard specifications for certain glass furnace refractory materials. He hoped it would also be possible to consider the formulation of specifications for some of the more important glassmaking materials, and the setting up of standard tests for glass itself.

Prof. Turner then gave a very comprehensive account of the growth of the British glass industry from the time of the Roman occupation to the present day. Speaking generally, there was a steady growth up to the year 1875, after which time the number of glass factories began to decrease and the imports of finished glassware increased. This steady decline was arrested on the outbreak of war in 1914, and during the last few months of 1914 and 1915 there was an infusion of new blood and the industry was revived. Certain new branches of the industry had under the stress of war to be created—the production of chemical glassware had to be undertaken, and the building up of a lampworking industry had to be begun. These new branches of the industry grew to such an extent that during the last twelve months of the war period more than two million pieces of chemical glassware were made at the furnace, more than 39 million lamp-blown articles were made, and more than a million pounds of glass rod and tubing were drawn. During this same period the output of electric lamp bulbs was in excess of 43 millions, while in pre-war years the output was not more than 4 million bulbs.

Turning to the future, Prof. Turner acknowledged that the immediate outlook was not cheerful, but claimed that the industry was much more efficiently equipped than at any other time in its history, and

provided that politicians could settle the problem of international exchanges before it was too late, they might look forward to a prosperous future. There was plenty of scope for new developments in the industry, and many novel uses to which glass may be put, so that there was no need to lose confidence in the industry.

The Very Reverend W. Foxley Norris, D.D., Dean of York, gave an interesting address on the Mediæval glass of York Minster. He pointed out that the windows of York Minster were the finest samples of the 13th and 14th century English stained glass that it was possible to find, and they were literally a priceless possession. Unfortunately the glass was showing signs of decay, and in some cases the deterioration was very pronounced. The work of cleaning the windows and releading them was proceeding, and they were also trying various means of preserving the glass itself from further decay.

A SENSITIVE TEST FOR PHENOLS.

BY JAMES MOIR, M.A., D.Sc., F.I.C.

(Read 19th September, 1921.)

(Reprinted from the *Journal of the South African Chemical Institute*, January, 1922.)

For phenols as such—i.e., not in solution, the best test is undoubtedly the distinctive colour of the phthaleins produced when the specimen is gently warmed with a trace of *p*-oxybenzoylbenzoic acid and a drop of sulphuric acid, and the result dissolved in ammonia (see Moir, *Trans. Royal Soc., S.A.*, 1918, 112; also Orndorff & Murray, *J. Amer. C.S.*, April, 1917).

It is well-known, however, that the ordinary tests for phenols break down if the reaction of the fluid to be tested is either markedly acid or markedly alkaline. The ferric chloride coloration for example can in practice only be obtained with a pure aqueous distillate containing nothing but phenol and water. Similarly tribromophenol is not characteristic, except in smell, unless perfectly pure. The mercury test and the chloroform test do not apply to dilute solutions.

Having had occasion to detect phenol in soap, in which the proportion of phenol was not more than 0.01 p.c., I devised the following process, which can be carried out if necessary on the original without distillation. The reagent is paranitraniline hydro-

gen and hydrogen mixture, the anhydride of formic acid, viz., carbon monoxide, is added, then, when saturated with water vapour, the mixed gases should react in chloride, and is made up in the same way as "Reagent A" of my test for nitrous fumes (This J. IV., January, 1921, foot of page 5), viz., 1.5 grams paranitraniline base dissolved in 500 cc. of hot water with the aid of about 40 cc. of strong hydrochloric acid.

"BROMINE."

AND ITS COMMERCIAL IMPORTANCE.

By John Missenden, B.Sc.

Bromine is a liquid element of the halogen group, and was first discovered in 1826, but was not produced in such quantities as to be of commercial importance until 1860.

Originally, it was discovered by Balard of Montpellier in the mother liquor obtained after the crystallisation of salt from sea-water to the extent of 10.5 grains in each ten gallons, and he succeeded in isolating it in very minute quantities. Later, it was discovered more abundantly in saline springs, particularly in those at Kreuznach and Kissingen, in Germany, but even with this discovery it did not become greatly applied to the cause of Science.

The most important source at the present time is the potash beds at Strassfurt, it being present in the mother liquor to the extent of 0.27 per cent. Here it is usually found in chemical conjunction with magnesium to form magnesium bromide ($MgBr_2$). The magnesium bromide is extracted from the crude carnalite which forms part of the potash deposits, and the pure bromine is separated from the magnesium by bringing the compound into contact with separately generated chlorine, the magnesium having a greater affinity for the chlorine than it has for the bromine.

More recently, an electrolytic process has been tried, and has been successful. It has been found that, when both magnesium and chlorine are found with the bromine (as, indeed, they often are), all the bromine is liberated before the chlorine.

Bromine is a deep red liquid, having a density of 3 at $17.8^\circ C.$, and it readily evolves red fumes, which are extremely destructive to animal tissue. Its name is derived from its irritating and suffocating odour by the word *βρομος*, meaning a

"stench." It is scarcely soluble in water, but is slightly more soluble in alcohol and ether. The weak solution that is produced by mixing it with water has very valuable bleaching properties. Its boiling point is $63.2^\circ C.$, and it freezes to a red crystalline solid at $-12.5^\circ C.$

Bromic acid, $HBrO_3$, is monobasic, and is perhaps the most familiar of the bromine compounds. It is produced in its free state by the action of silver bromate, $AgBrO_3$, on pure bromine, forming silver bromide, $AgBr$, and bromic acid. It is responsible for a somewhat extensive series of bromates, the majority of which are of no commercial value.

Potassium bromide, KBr , is prepared by the action of bromine on potassium hydrate, KOH , the hydroxyl group being driven off. It is greatly used as a medicine for nervous diseases, such as delirium tremens, sleeplessness, epilepsy, hysteria, and in other complaints where a depression of the nervous system is desirable. Because of this valuable property, many people are inclined to use it to excess in order to still nervous excitability. This use—or, rather, abuse—of the medicinal properties of potassium bromide is the cause of a complaint known as "bromism," the symptoms of which are skin eruptions and growing muscular and sexual weakness. Those who indulge in the taking of this drug are familiarly known as "Bromides," but their internal lassitude soon disappears when they cease to take the substance. The excessive use of potassium bromide has been responsible for many evils, and, in certain sections of society, has led to an unhealthy state of mind which makes it a considerable danger.

In photography, a 10 per cent. solution is very efficacious in retarding the action of a developer, and is known as a "restrainer."

Bromoform (or tribromomethane) $CHBr_3$, is a clear, heavy liquid analogous to chloroform, and was first discovered by Lowig in 1832, but its true nature was discovered by Dumas. It is mostly used for separating and determining densities in mineralogical processes, and is also used to a slight extent in medicine.

Silver bromide, $AgBr$, is mostly familiar in connection with photography, it being sensitive to light, and forming what are known as "bromide prints." The printing paper is coated with an emulsion of silver bromide in gelatine, with or without other

silver halloids, and is used for obtaining prints by development either by contact printing or by enlarging with day or artificial light.

There are other bromides, such as sodium, antimony, and lithium, but they are little in demand, being of small or no commercial value.

INTERNATIONAL ECONOMIC IMPORTANCE OF PRECIOUS STONES IN TIMES OF WAR & REVOLUTION.

BY DR. GEORGE F. KUNZ,

President, American Scenic and Historic Preservation Society.

(Reprinted from "*The Scientific Monthly*," March, 1921).

Almost from time immemorial, gold and silver have been acknowledged as the standard precious metals. For twenty-five centuries they have been used in coinage, varying from gold at eight times to forty-five times the value of silver and now receding to about fifteen times. Up to the present time seventeen billion dollars' worth of gold has been mined, of which five billion has been lost, leaving twelve in circulation and in the arts. There are now in the governmental treasuries or in banks, approximately nine billion dollars' worth. Frequently treasures of gold are found in earthen or leaden pots, dating from five centuries before Christ to the Christian Era, which are absolutely perfect and as intact as the moment they arrived from the mint.

Although at various times in various parts of the world, corn, rice, rock salt, cocoanuts, dates, shells, whale's teeth and wampun have been used as a medium of exchange, they only had a local value and were not international. The paper moneys of the world have little durability, and there is scarcely a paper note known that has held its value for more than a century. Even our own Colonial bills, and bills of the Confederate States have no value other than to an antiquarian. Of all known metals, nothing possesses the compactness in value, the rarity, the richness and the convertability in every capital of the world, of precious stones, whereas 100 ounces of gold would be as much as any individual could comfortably carry about with him, approximately \$2,000 worth.

Precious stones in all times have been prized as the only objects that can be transported in great value with the least possible bulk. Many precious stones have such value that a million dollars' worth do not weigh more than a few ounces to a few pounds, and in the great World War and the aftermath of the War, in Russia and other European countries, these were hurriedly bought, and there are many instances on record in which they were the only objects that it was possible for the owner to flee with, sometimes at only half an hour's notice, and, as they have no international mark, as would a coin or a banknote, they could be converted in any country to which a refugee departed.

In regard to paper moneys, with the exception of the money of the United States, all other issues have depreciated over 10 per cent., or, in some instances, as in Austria and Russia, have fallen to only 1 per cent. of the original value; and as precious stones exist to the value of \$3,000,000,000, this is a large enough value to have an economic importance in times of war and stress. As to permanency of value, the Regent Diamond, sold to France in the time of Louis XV., to-day, after changes from kingdom to republic, consulate and empire, and again to republic, is itself unchanged and as precious as the day it was bought in its rough state by Thomas to procure funds indispensable to the consolidation of his power. History tells us Pitt, in the early eighteenth century. Bonaparte pledged it to the Dutch Government how the great diamond of Charles the Bold was placed as a loan with the Fuggers of Augsburg, the great money-lenders of the fifteenth and sixteenth centuries, or by the inhabitants of India before money could be placed at interest, as forming the only absolutely transferrable international medium of exchange.

About 6,000,000 ounces of platinum have been found, worth about \$80 per ounce, approximately \$500,000,000, of which two-thirds has been used by dentists and chemists. Therefore it would not be a factor in world values; and is not so easily understood or recognised as is gold or silver.

Preciousness consists of indestructibility, rarity, portability and convertibility. Thus, gold is one of the most important of the precious metals. Alexander the Great, in his time realised that by transporting gold to India, instead of silver, his camels

carried thirteen times as much in value. At that time the ratio was about thirteen to one.

The Sultana of Sulu owned a necklace of beautiful pearls. When visitors tried to buy them, she said, "Why should I sell them?" They said, "We will give you money for them." She said, "What can I do with the money? If the enemy comes, it is too heavy to flee with. My pearls I could take with me, and if I need money I can always sell a pearl." The Sultana realised the portability and value of pearls

PLATINUM.

By GEORGE F. KUNZ.

(Continued from Last Week).

PLATINUM METALS IN FOREIGN COUNTRIES.

Australia.—In Tasmania, while platinum deposits have not yet been discovered, although a little of the metal has been secured in the refining of blister copper, osmiridium deposits of some importance have been found on the Savage River (Bald Hills) and Wilson River, in the north-western part of the island. Here it appears in areas of serpentine, in the form of nuggets and fine grains in alluvial deposits, with magnetite and chromite, and close to the boundary of sedimentary rocks and the intrusive serpentine. Regarding these osmiridium deposits, Mr. A. I. Reid, Assistant Government Geologist of Tasmania, gives the following information:¹

"The occurrence of bronzite, ensatite, and olivine in peridotites, pyroxenites, and gabbros—or in serpentine resulting from the decomposition of these rocks—is considered to be favourable for the presence of osmiridium, while monoclinic pyroxenes, such as augite and diallage, appear to be limited to rocks barren of osmiridium. The deposits containing osmiridium are almost exclusively confined to differentiation streaks, or 'schlieren,' in structural planes developed in the rock, and not only is it possible to distinguish the osmiridium-bearing serpentines from those that are barren, but the precise location of the deposits in these rocks can be fixed without difficulty. Other interesting features are the presence

of chrome spinel in the serpentines and the high percentage of alumina in bronzite."

The osmiridium output of Tasmania has fluctuated considerably since 1910, when the local government began to take official cognizance of it, and when 120 oz. of the precious metal was produced. By 1912, the output had risen to 778 oz., and in 1913 it was 1,261 oz. Although mining was partially checked in 1914 by the outbreak of the war, 1,018 oz. were recorded for that year. Then came the poor years 1915 with 247 oz., 1916 with but 222 oz., and 1917 with 332 oz. In 1918 the demand for the metal for war munitions sent the production up to 1,606 oz., and in 1919 the output was 1,669½ oz. A curious circumstance is reported concerning the osmiridium deposit on the brow of Bald Head, in the Savage River district, facing Nineteen Mile Creek, for the official bulletin states that here a miner has been quarrying solid serpentine rock for over 6 years, and has secured high-grade osmiridium by crushing this rock. The assertion is made that he is the first and only miner in the world to find the metal actually occurring in the solid rock.¹

The 1920 output was the largest yet recorded, amounting to 2,009 oz., valued at £77,114.

Regarding the sources of the platinum and associate minerals found in the black sands at certain localities of Australia, such as Ballina, near the mouth of the Richmond River, Evan's Head further to the south, and Currumbin, near the mouth of the Tweed River, northward of the locality just mentioned, Mr. Dunstan, Chief Government Geologist, admits that in the case of the associated minerals the source is problematical, but he considers that the platinum and osmiridium were probably derived from the serpentine area, which forms in part the western edge of the Clarence coal measures. He further states:²

"Possibly in former times the platinum and other minerals, each from their individual source, were accumulated in the sediment forming the Clarence series of rocks, and which natural agencies are now redistributing in the coastal sands. Along this coast the disposition of sand is nor-

¹Cited by B. Dunstan in *Queens. Govt. Min. Jour.*, Jan., 1921, p. 20.

¹*Min. Sci. Press*, Aug. 14, 1920.

²*Queens. Govt. Min. Jour.*, Jan., 1921, p. 20.

therly from the rivers bringing the material down from the high lands, and this suggests the idea that the sources of the minerals are always south of the beach deposits in which they happen to occur. Some of the Currumbin sands, indeed, have been found to contain chromite, which rather indicates the serpentine to be the source of some of the minerals contained in them."

"At Ballina and Evan's Head the platinum is the predominating mineral in the sands, with gold in small quantities, while at Currumbin, further north—and further from its source—the platinum is only in traces, with the gold in greater quantities. In California and Oregon, platinum is found in the beach sands of the Pacific Coast and evidently under similar conditions to those at Ballina and Currumbin."

Canada.—While the Canadian production of platinum metals has increased somewhat in recent years, it is still far below what might be expected. The International Nickel Co. of Canada, in the refinery at Port Colborne, Ont., reports a recovery in 1920 of 88.7 oz. of platinum in an impure state, besides 173.8 oz. of palladium, and 19.6 oz. of rhodium, ruthenium, osmium, and iridium. At the New Jersey refining plant of this company, where the recoveries are believed to be mainly if not exclusively from Sudbury, Ont., matte, there were secured 488.9 oz. of platinum; 739.2 oz. of palladium; 309.3 oz. of rhodium, and 102.4 oz. distributed among the platinum metals, osmium, iridium, and ruthenium. In the refinery of the British America Nickel Corporation at Deschenes, Que., the residues from the refining operations are being stored for future treatment.

There should be added to the quantities mentioned a platinum production of 17 crude oz. in 1920 from alluvial sands, even less than the 25 oz. recovered from the sands in 1919. The Canadian exports of platinum in 1920 were 473 oz. of ore, concentrates, etc., valued at £53,956, and 317 oz. of "scrap" platinum, valued at \$31,781.¹

It is asserted that platinum deposits of great value can be derived from the Fraser River, British Columbia, and from three of its tributaries, the Quesnel, Mellon, and Cottonwood rivers. The statement is made

that for a stretch of 250 miles along the Fraser, and for about 150 miles on each of the three tributaries, as much as 75 per cent. of the black sands can be profitably worked. Tests are said to show that the sands yield from 8 to 40 lb. of concentrates per cubic yard. The value of these concentrates varies greatly, ranging from \$40 up to \$1,200 per ton. Besides platinum, they contain iridium and osmium; there are also smaller quantities of the other platinum metals, palladium, ruthenium and rhodium. The Cariboo Gold and Platinum Reduction Co. has established a plant, and was prepared to begin active operations in the spring of 1921. Should the expectations be realised, British Columbia should furnish a considerable amount of platinum and of the other platinum metals.

Chile.—The black sands on the coast of the Island Chiloe, which belongs to Chile, have lately been proved to hold a considerable quantity of platinum in addition to the gold they contain. The deposits are due to the erosive action of the waves, and the eroded material has been concentrated by the movement of the sea. The amounts of black sands vary notably, constituting as much as 50 per cent. of the deposit at some places, while at others there is but a trace. The concentrates are usually secured near to the present high-water mark. Platinum is found in appreciable quantities only from Tablacura beach and southward, the richest deposits being those of Lavaderos beach. This is near the extreme south-western point of the island, immediately south of the Zorras River. This beach is of considerable extent, having a length of only about 25 metres at high tide, but the richest concentrates occur in a strip 25 metres wide between high and low tide. The platiniferous sand averages from 10 to 20 cm. in thickness, and lies over a false bed-rock of clay, and beneath an overburden of 50 cm. of light-gray beach sand; there is said to be a second layer of platiniferous sand beneath the bed-rock. An examination of samples taken at random indicates from 1½ to 2 gm. of platinum per cubic metre. It occurs in thin flaky scales, and is in a free state; there is an iridium content of about 10 per cent. An attempt is being made to exploit the sands by means of a dragline operated by steam, and having a daily capacity of some 20 cubic metres. After screening, the sands are to be passed over amalgamating plates to re-

¹Prelim. Rept. Min. Prod. of Canada, 1920, Can. Dept. of Mines.

move the gold, and they are then to be concentrated on stationary canvas and burlap tables, to secure the platinum. The plant has been so recently installed that no data as to results are yet to be had.¹

The island of Chiloe, where these platinum gravels have been found, is about 100 miles long, and averages some 30 miles in width. It is divided from the mainland of Chile by the Chacao Channel, and is bounded on the east by the gulfs of Ancud and Corcovado, which constitute the northern end of the inside waterway to the Strait of Magellan. Small freight steamers, of almost 50-ton register, run between the island and Puerto Montt, the southern terminal of the Chilean Government railway. The time required for the journey from Ancud on the island to Puerto Montt is from 8 to 9 hours, and the railway trip thence to Santiago takes about 24 hours.

Colombia.—The two great platinum-bearing rivers in Colombia are the Atrato and the San Juan. Of these, the former, which empties into the Gulf of Darien, is about 300 miles long, is navigable by steamers for two-thirds of its course, and discharges an immense volume of water during and immediately after the rainy season. Although the bars at the river's mouth are only from 5 to 6 ft. below the water's surface, the channel is from 750 to 1,000 ft. wide, and has a depth of from 40 to 70 ft. for 100 miles; even at Quibdo, which is 220 miles inland, the river is from 8 to 20 ft. deep and 850 ft. in width. The navigable stretch for steamers reaches some 30 miles farther up, to the confluence of the San Pablo and Certigui rivers. The San Juan is not quite so long as the Atrato, but to its 245 miles should be added the length of a number of affluents, and with these we can count nearly 300 miles of water open to navigation, though only for 140 miles by steamers. It has a width of from 300 to 1,200 ft., and discharges into the Pacific 50,000 cu. ft. of water per second, which is a greater volume than is discharged into the Pacific by any other of the South American rivers. Another great source of Colombian platinum is the region of the Condoto River, but this has not yet been thoroughly explored, so that nothing

approaching an exact estimate can be made of its productivity.¹

It is becoming more and more generally recognised that the \$25,000,000 indemnity to be paid by the United States to Colombia will be made to contribute to the prosperity of the nation according to it. For this money, as well as loans for which it will serve as a basis, will be expended in developing the great natural resources of Colombia, not the least of which is its platinum, and the greater the production of this extremely useful metal, the greater will be the quantity available for export to the United States. This will supplement the efforts already being successfully made by capitalists of the United States to increase the platinum output from Colombia's alluvial deposits.

¹J. Ovalle, "Platinum in Colombia," *Eng. Min. Jour.*, Nov. 6, 1920.

(To be Continued.)

PROCEEDINGS AND NOTICES OF SOCIETIES.

ABSTRACTS OF THE PROCEEDINGS OF THE GEOLOGICAL SOCIETY OF LONDON.

April 12th, 1922.

Prof. A. C. Seward, Sc.D., F.R.S., President, and afterwards Dr. H. H. Thomas, V.P.G.S., in the Chair.

The following communications were read:—

1. "*Oligocene Mosquitoes in the British Museum, with a Summary of our present Knowledge concerning Fossil Culicidae*," by F. W. Edwards, B.A.) Communicated by the Secretary.)

The material dealt with in this paper is in part the property of the Geological Department of the British Museum, and in part belongs to Mr. R. W. Hooley, F.G.S. The study of it was undertaken by the author at the suggestion of Prof. T. D. A. Cockerell and by permission of the Keeper of the Department. All the specimens are from the Oligocene of the Isle of Wight.

The result of the study confirms what was already known of the Oligocene insect-fauna. The genera appear to be inseparable from those living at the present day, and the indications supplied by some of

¹Fritz Mella, "Black-sand Deposits of the Island of Chiloe," *Eng. Min. Jour.*, Mar. 19, 1921.

the species suggest a fauna similar to that of the Ethiopian and Oriental regions at the present day.

No light is thrown by the fossils on the phylogenetic history of the Culicidae, nearly all the recent types being represented in the Oligocene fauna, and no peculiar forms occurring. The genus *Anopheles*, however, has not been found, probably because of its comparative rarity.

The three species described from the Oligocene of the Isle of Wight by Prof. Cockerell are discussed in detail, and are referred to the genus *Aedes* in the broad sense. Two new species, one of *Culex* and one of *Teniorhynchus*, are described.

A critical summary is given of our present knowledge of fossil Culicidae. No fossil that can be positively referred to this family is yet known from the Mesozoic.

2. "*On a Collection of Carboniferous Plants from Peru*," by Albert Charles Seward, Sc.D., F.R.S., Pres.G.S.

The plants described by the author were collected by Mr. J. A. Douglas in 1911 from coal-bearing strata on the south side of the Peninsula of Paracas, a few miles south of Pisco on the coast of Peru. Although the specimens are few in number and for the greater part fragmentary, they are of considerable interest: they demonstrate the occurrence on the coast of Peru of Carboniferous strata; whether the plants should be referred to an Upper or a Lower horizon is not certain. Hitherto no fossiliferous Palæozoic rocks have been recorded from the Peruvian coast.

3. "*The Geological History of the Genus Stratiotes: an Account of the Evolutionary Changes which have occurred within the Genus during the Tertiary and Quaternary Eras*," by Miss Marjorie Elizabeth Jane Chandler. (Communicated by Mrs. E. M. Reid, B.Sc., F.L.S., F.G.S.)

Stratiotes, a monotypic genus of European and West Asian water-plants, is the descendant of a line of ancestors which can be traced back to the Eocene. The seeds have long been known in the fossil state as *Folliculites*, *Paradoxocarpus*, etc., but their relationship with *Stratiotes* was not recognised until 1896. For many years the subject was in hopeless confusion, because the species were ill-defined and the types and type-localities lost or inadequately studied.

The recent seed is first investigated, and an account then given of the modifications which have occurred in the genus since the Eocene Period. Nine species are described or redefined, of which *S. Aloides* alone is still living. Seven of them appear to constitute links in an evolutionary chain which terminates in the recent plant, while two perhaps represent a branch-line of evolution, distinguished by certain peculiarities of form and raphe.

As the fossil species occur in great abundance, and as several of them are widespread geographically, while each seems to have a limited range in time, there is a hope that *Stratiotes* may prove of value in the correlation of isolated freshwater deposits in Europe.

The next meeting of the Society will be held on Wednesday, May 10th, 1922, at 5.30 p.m., when the following communications will be read:—

1. "*The Lower Carboniferous Succession in the Settle District and along the Line of the Craven Faults*," by Prof. E. J. Garwood, Sc.D., F.R.S., and Miss E. Goodyear, B.Sc., F.G.S.

2. "*The Miocene of Ceylon*," by E. J. Wayland, Assoc. R.C.S., F.G.S., and Dr. A. Morley Davies, Assoc. R.C.S., F.G.S.

The meeting to commemorate the 75th anniversary of the foundation of the Association des Ingenieurs de Liège will be held during the week commencing Sunday, 18th June. Details of the proceedings will be published shortly.

At the Forty-Fourth Annual General Meeting of the Institute of Chemistry, the Meldola Medal was presented to Dr. Christopher Kelk Ingold, in recognition of his work on the structure of Carbon Compounds. After the presentation, the President's address, which appears in this issue, was given.

ROYAL INSTITUTION OF GREAT
BRITAIN.

On Saturday, May 6th, at 3 o'clock, Professor D. H. MacGregor, M.A., M.C., on "*Industrial Relationships*": (II.), "*The Problem of Structure*."

THE INSTITUTE OF METALS.

Westminster, S.W.1, April 25, 1922.

TRANSMUTATION OF THE ELEMENTS.—Sir Ernest Rutherford, F.R.S., who has recently been elected President of the British Association, delivered the twelfth annual May Lecture before the Institute of Metals at 8 p.m. on Wednesday, May 3rd. The work which has lately been done concerning the transmutation of elements lends especial interest to the discourse, the subject of which was "The Relation of the Elements."

SWANSEA MEETING OF THE INSTITUTE OF METALS.—The annual autumn meeting of the Institute of Metals will be held at Swansea on September 20-22. A ballot for the election of Members and Students desirous of participating in this and other meetings of the Institute will take place on July 13. Membership particulars can be obtained from the Secretary of the Institute of Metals, 38, Victoria St., S.W.1.

CORROSION OF CONDENSER TUBES.—A second and revised edition has just been issued by the Corrosion Research Committee, 36, Victoria St., S.W.1, of the valuable pamphlet entitled "Notes on the Corrosion and Protection of Condenser Tubes." The document, which is published at 2s. 8d. post free, is intended to be of service to manufacturers of tubes and condensing plant, and to the engineers who use them. It is of an essentially practical character, and embodies the results of ten years' research. The first edition of 1,000 copies was exhausted within a week of publication. The new edition contains much valuable additional matter.

THE SOCIETY OF DYERS AND COLOURISTS.—MANCHESTER SECTION.

THE ANNUAL SECTIONAL MEETING.

THE ANNUAL REPORT.

The Hon. Sec. then read his Annual Report of the proceedings of the Section, in which it was stated that the total membership of the Section was 394, this being an increase upon the previous year. The following papers had been read at the General Meetings: "Methods for the Identi-

fication and Valuation of Coals," by Capt. F. S. Sinnatt, M.B.E., M.Sc.Tech., F.I.C., M.I.M.E.; "On the Behaviour of Oxidised Cellulose towards the Direct Cotton Colours," by Prof. E. Knecht, Ph.D., M.Sc.Tech., F.I.C.; "Notes on Fur Dyeing," by W. F. A. Ermen, M.A.; "On the Estimation of Indigotin," by Wm. Thompson, F.R.S. (Ed.), F.I.C.; "Some Laboratory Notes," by Prof. E. Knecht, Ph.D., M.Sc.Tech., F.I.C.; "A Note on the Tinctorial Value of a Sample of Mauve made about the year 1864," by Miss Eva Hibbert, M.Sc.Tech.; "On the Inter-relation of Mercerisation and Spinning," by Horace Lowe; "On the Tinctorial Properties of Some Anthocyanins and Certain Related Pigments," by A. E. Everest, D.Sc., Ph.D., F.I.C., and A. J. Hall, B.Sc., F.I.C.; and "On the Effect of Scouring and Bleaching upon the Structure and the Strength of Cotton Fabrics," by J. Huebner, M.Sc.Tech., F.I.C. The attendances at the meetings of the Section had been very satisfactory. Arrangements have been made for five further meetings, at which papers of interest and value will be read and discussed.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, THURSDAY, MAY 4TH, 1922, AT 8 P.M.

The following papers will be read:—

Brome-derivatives of glyoxaline.—I. E. Balsban and F. L. Pyman.

The properties of ammonium nitrate. Part IV.: The reciprocal salt-pair $\text{NH}_4\text{NO}_3 + \text{NaCl} \rightleftharpoons \text{NH}_4\text{Cl} + \text{NaNO}_3$.—E. P. Perman.

The reactivity of ammonia.—E. G. C. Baly and H. M. Duncan.

Photocatalysis. Part II. The photosynthesis of nitrogen compounds from nitrates and carbon dioxide.—E. C. G. Baly, I. M. Heilbron and R. P. Hudson.

"THE PREPARATION OF CLOTH FOR FINISHING."

By S. H. HIGGINS, M.Sc. (BLEACHERS' ASSOCIATION, LIMITED), AND ANDREW HODGE (CALICO PRINTERS' ASSOCIATION, LIMITED).

The paper commenced by a reference to the statement of Mr. W. Howarth at the World Cotton Congress, Manchester, 1921, respecting the characteristics of raw cotton

which enabled a spinner to attain the best results with a minimum of labour, i.e., the fibres must be even in length, the cotton must be ripe, the grade must be even, and the cotton must be as free as possible from "dead" cotton, bearded motes, seed, fibres other than cotton, sand, iron, stones, excessive moisture and other foreign substances. The finisher's objective was also to achieve the best results with a minimum of labour, and his success was very closely dependent of the success of the spinner in obtaining supplies possessing the characteristics referred to by Mr. Howarth. By full discussion of the difficulties caused by the lack of these characteristics, not only in spinning, but in the subsequent processes of bleaching, dyeing, printing and finishing, it was believed that the spinner's hands would be strengthened in his attempts to secure the quality of cotton he requires.

The faults in cotton piece goods which hamper the finisher in his attempts to produce the best result are, roughly, cotton faults, mechanical faults, and chemical faults, including those associated with the size.

Dealing with cotton faults, it was stated that "black" cotton could not be bleached to a pure white, the finished piece being dull and almost grey in appearance. Cloth woven from such "black" cotton should never be delivered to White finishers or Calico printers, but should be sent for black dyeing. Blue Bender cotton is a variety of Peeler cotton, and had a bluish colour which could not be removed by the usual methods of bleaching. The name is given owing to the fact that it grows in the bends of the Mississippi River Valley. Some authorities are of opinion that its coloration is brought about by premature frost, while others think it is due to some ingredient in the soil. Apart from its colour and resistance to bleaching, the appearance and quality of the fibre are unimpaired. The United States Department of Agriculture finds that middling tinged cotton, when bleached, can be used for dyeing both light and black shades, but good middling blue stained and middling blue stained can only be bleached satisfactorily for dyeing dark shades.

Unripe fibres are responsible for spinning difficulties resulting in the formation of neps resisting the penetration of the colour. Many cloths, particularly those woven with the coarser counts of yarn, contain a very

large proportion of leaf which remains from a pale buff yellow to dark brown after the goods have received a normal bleach. This is a very objectionable feature in many styles, and at its worst leaf is also capable of showing speckiness in the ultimate dyed goods as illustrated in one of the examples.

The mechanical faults took the form of unevenly spun yarns, uneven weaving, floats, etc., the most outstanding of them all being probably uneven weaving, which gives alternatively thick or thin places in the weft, or reediness in the warp, and which, although in many cases hardly noticeable in the grey, show up in the ultimate dyed or printed goods as light and dark places, constituting what is known as streaminess. A defective sand roller on a loom sometimes causes minute holes in the cloth, which are enlarged in the bleaching process. The temple of the loom causes similar holes, but at the sides of the cloth, while the grey plaiting machine also causes damage from time to time. These damages in the form of small holes are difficult to trace to their source. Pins, teeth of steel combs, hairpins, etc., left in cloth by weavers cause stains and tears. It is quite customary to find heddle wires in calenders from goods woven in Jacquard looms, thus causing small round holes to be cut in the cloth going through the calenders. Cropping machines sometimes cause small holes by pulling bits of cloth out along with the loose threads, and can also damage cloth by the blades not being properly adjusted.

The paper also dealt with the structure of the selvedge, which was a matter of importance to the finisher. In some cases a curling selvedge rendered printing, dyeing and finishing difficult if not practically impossible. In order to obtain certain finished effects a definite process must be followed and the cloth must have a definite large number of runnings, but if finishers give more runnings to the cloth than is absolutely necessary, the cost of production is too high. If selvedges are hard and round, instead of having a flat tape appearance, they are liable to cut or tear away from the body of the cloth, and if the threads in the selvedge are badly drawn they tend to form a hard, solid selvedge, which may be an advantage in weaving, but gives trouble when calendered. Irregularity in the manner of threads in a selvedge caused by bringing in loose ends will sometimes cause damage in those places where

extra threads have been introduced. There would be little trouble with faulty selvages if the whole-hearted co-operation of the mill manager could be obtained.

With regard to chemical faults, including those associated with size, these took the form of excessive quantities of size being used, and from the use of undesirable ingredients in the size, such as zinc and magnesium chlorides, paraffin wax or tallow containing paraffin, and from the use of colouring matters which cannot be bleached out. All the size put into the warp has to be removed by the finisher during the process of bleaching, and the less he has to remove the better. Many cloths are now delivered free from chlorides, though some of the ready-made softened sold for use in sizing contain chlorides, and a manufacturer buying such products might be using them unwittingly. The use of China Clay in sizing light goods is also not to be recommended. Fatty matter in the size is a fruitful source of trouble to the finisher, even when it consists of pure tallow which is mainly saponifiable. Some cloths contain as much as 2.5 per cent. of fatty matter while other similar cloths only contain 0.6 per cent. Many commercial tallows are adulterated with unsaponifiable paraffin wax which is not removed in the process of bleaching, and gives rise to stains in the finished goods. Japan wax, being only partially saponifiable, is not suitable for sizing mixings. Paraffin and similar waxes should not be allowed in the weaving shed.

The practice of covering up a float or other weaving defect with paraffin wax, or soap containing it, is also to be deprecated.

Stains due to mineral oil are another difficult problem from the point of view of the finisher. They occur when there is contact with the yarn or cloth in the course of spinning or weaving, from drippings from the roof or from the slasher cylinder covers, yellow or black bars from cracked bobbins, the oil getting on to the roving, or oil from the roller necks, and in the top boards in the card room. When the weaver pieces a thread an oil stain will result if she has oil on her fingers, and this stain cannot be removed in the ordinary bleaching process. Marks from picker bands due to oily and waxy matters in the stuffing of the leather will not come out, but leave yellow marks. If lubricating oil has come from a bearing and contains any copper or iron from the machinery, the trouble is greatly aggra-

vated. The metallic particles are not completely removed by scouring, and act on the chemic, giving off oxygen, thus tendering the cotton with which they are in contact. It is an exceedingly dangerous practice to attempt to remove these metallic stains by treatment with Oxalic Acid or Salts of Sorrel. If the acid is not completely removed by washing, local, and perhaps more than local, tendering may occur. Lard oil is saponifiable in the bleaching process. Some years ago it was shown that by using a lubricating oil containing 75 per cent. of colza oil and 25 per cent. of mineral oil any oil stains would be removed in the bleaching process. White lead stains from looms and other parts of the textile machinery will not bleach out, but leave light brown stains. The bleeding of dyestuffs in the bleaching process also causes a considerable amount of trouble. It is more likely for variations to take place in the process of dyeing, which is sometimes a long and difficult one, than in the process of bleaching, which is more or less standardised.

Difficulties also occur when "gold headings" have to be dealt with by the bleacher. There appear at times to be variations in the quality of the gold thread, blackening of the thread and the tendering and destruction of adjacent cotton threads. Manufacturers have at times bought inferior gold which would not stand the bleaching process. Instead of being a drawn silver wire with an extremely thin coating of gold, it has sometimes been a gilt copper wire.

If attempts are made to remove foreign matters, such as paraffins, by more drastic methods of bleaching, the finisher runs two serious risks; first, that of rendering his cloth unsuitable for the finished effect required, and, second, of weakening or actually rotting the cloth. Otherwise the finisher is continually attempting to remove all foreign matters as completely as possible.

The finisher ought to insist that no chlorides or unsaponifiable waxes shall exist in the cloth he receives.

With regard to stretching goods to width it must not be forgotten that there is a certain amount of stretch which can be given to fabrics beyond which the strength of the fabrics is decreased.

A discussion followed, in which Messrs. Knecht, Hannay, Thomson, J. Campbell Gray and Jones took part.

Mr. J. Campbell Gray proposed, and Mr. Jones seconded, a vote of thanks to the authors for their paper, and to Dr. Harland for his explanation of the screen illustrations.

[Abridged report, by F. W. Baber, of a paper read before Society of Dyers and Colourists, Manchester Section, on Friday, April 21st, 1922.]

CHEMICAL NOTICES FROM FOREIGN SOURCES

THE MONOCHLORTOLUENES.—A. Wahl, G. Normand, and G. Vermeulen.—The chlorination of toluene leads to the formation of a mixture of ortho and parachlortoluene, the properties of which have been variously described by different authors. The study of the density of the product obtained in presence of 2.5 to 3 per cent. of iron shows that between temperatures of 0° and 20° the composition is practically 57 or 58 per cent. of the ortho to 43 or 42 per cent. of the para compound. The influence of the temperature is only very slight, and chlorinations performed at 30°, 40°, 50°, and 60° lead to almost the same result. If aluminium is used instead of iron in the chlorination, the mass becomes coloured, and on distillation an abundant residue of polymerised products is left. The authors have not been able to observe any reaction when toluene is chlorinated in presence of ammoniacal lead tetra chloride. In presence of PbCl_2 chlorine begins to act at the temperature of the water bath, but while in absence of a catalyst only benzyl chloride is formed, in presence of PbCl_2 toluene chloride is chiefly formed, the percentage of ortho compound being about 62, or slightly above the normal amount.—(*Comptes Rendus*, CLXXIV., 1922, No. 14.)

TITRIMETRIC DETERMINATION OF ALUMINIUM.—E. J. Kraus.—The aluminium is precipitated as hydroxide, and after separation from iron is dissolved in sulphuric acid, the amount of acid used being such as to make the solution neutral or very slightly acid. Then some drops of a solution of silver nitrate are added, and the solution is titrated with a standard solution of Na_2HPO_4 , which produces a white precipitate of AlPO_4 . The end point of the reaction is reached when a drop of the reagent causes a yellow colouration due to the formation of Ag_3PO_4 .—(*Chem. Zeit.*, XLV., 1921, p. 1,173.)

DETECTION OF SMALL QUANTITIES OF PYRIDINE.—A. Goris and A. Larssoncau.—To detect pyridine in the volatile bases obtained from belladonna leaves, the authors made use of the fact that pyridine combines with $\text{C}_6\text{H}_5\text{NH}_2$ in presence of CNBr to give a red crystalline compound of melting point 162°, viz., α -amido-phenyl dihydro-pyridinium bromide. One drop of aniline, one drop of pyridine, 1 or 2 cc. of water, and 0.05 to 0.1 gr. of freshly prepared CNBr are mixed, and at once a red precipitate of crystalline needles is formed. By means of this reaction, one drop of pyridine can be detected in ten litres of water. The reaction is not given by pyrrollic derivatives and can therefore be employed to detect pyridine in presence of methyl-2-pyrrolidine, which is very abundant in the volatile alkaloids obtained from belladonna leaves.—(*Bull. Soc. Pharm.*, XXI., 1921, p. 497.)

ZIRCONIA AND ZIRCONIUM.—The two chief sources of zirconium are zircon, or zirconium silicate ZrSiO_4 , found in Norway and in Ceylon, and brazilite, zirconium oxide ZrO_2 , found also in Ceylon and in Brazil. Pure zirconia is one of the most refractory substances known, its melting point being 2,950°. Like fused silica, it can be subjected to abrupt changes of temperature without being broken. In hardness it is intermediate between quartz and corundum. Chemically, it is very inert, being unaffected both by acids and alkalis, and in this respect is unlike any other refractory substance. It is used to make a silica glass, known as siloxide, in the enamel industries, in the manufacture of electric porcelain, and as a refractory material. It can be employed for making laboratory ware such as crucibles, tubes, etc. Platinum can easily be fused in zirconia crucibles, and they can be employed in studying the boiling point of pure iron. In order to prepare zirconium it is best to reduce zirconia either by means of aluminium or by calcium. An intimate mixture of zirconia and calcium filings in excess is heated in an iron tube at a pressure of 0.1 to 0.5 mm. of mercury till the reaction begins; then the contents of the tube are cooled, powdered, treated with cold water, acetic acid, dilute hydrochloric acid, and water, so as to eliminate the calcium. The product is finally washed in acetone and dried in vacuo, all these operations taking place in absence of air. Zir-

conium is a greyish metal, similar to silicon. Like nickel, it can be highly polished. It melts at about $1,600^{\circ}$, and its hardness is 6.5. It gives alloys with iron, nickel and aluminium, and is almost unaffected by acids, except aqua regia and hydrofluoric acid. It is used in the form of alloys or

as zirconium steel; one alloy containing 56 per cent. of zirconium, 26 per cent. of iron, 9 per cent. of aluminium, and 9 per cent. of titanium, is almost inoxidisable and fusible only with great difficulty. It is proposed to use it to replace platinum.—(*L'Age de Fer*, XXXVIII., 1922, 1,572.)

GENERAL NOTES

DETERMINATION OF SOLUBILITY.

By G. W. WALKER.

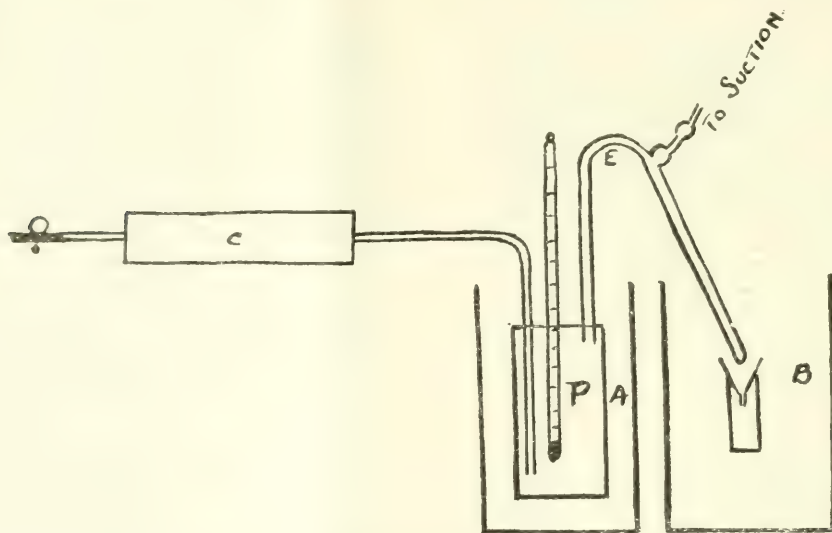
The author had occasion to determine the solubilities of various solids in water at different temperatures. The usual method of forming a saturated solution then filtering off a portion was found to be unsatisfactory on account of loss of temperature during manipulation. The difficulty is obviated by use of the apparatus as in sketch.

The beaker A contains water or other

suitable liquid in which the flask containing the solid and solvent is held. B is an air-bath containing the filter and weighing bottle. C is a combustion tube containing potassium hydroxide to eliminate CO_2 from the air.

Hot air is drawn through the apparatus, and serves to keep the solid in agitation. When the requisite temperature has been reached, the leading tube E is inserted into the saturated solution and suction gently applied. Some of the contents of F are then filtered off and at the required temperature. Of course the air-bath is kept at the necessary temperature.

Careful manipulation will give satisfactory results over a range of temperatures.



AN ALLEGED SYNTHESIS OF AMMONIA.

By A. J. PRINCE, RESEARCH STUDENT,
EAST LONDON COLLEGE.

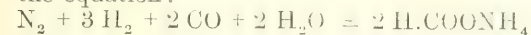
In the German Patent No. 74,275, entitled "A Process for the Synthetic Preparation of Ammonia," de Lambilly states that an increased yield of synthetic

ammonia should be obtained if, instead of dry gases, nitrogen and hydrogen saturated with water vapour are employed, thereby producing ammonium hydrate. Further: "Ammonia in the presence of an acid, or what amounts to the same thing, ammonium hydrate in the presence of an acid anhydride, behaves as an energetic base, . . . and hence, if to the correct nitro-

gen and hydrogen mixture, the anhydride of formic acid, viz., carbon monoxide, is added, then, when saturated with water vapour, the mixed gases should react in the presence of certain porous bodies, with production of ammonium formate." As suitable catalysts, pumice, wood-charcoal and bone-charcoal are mentioned, while platinum sponge and platinum black are especially recommended. The best yields should be obtained between the temperatures of 80° C. and 130° C.

Such a process as this would be of the utmost importance to the synthetic ammonia industry, since it provides an easy and efficient method of manufacturing ammonium salts from water-gas. With the idea of investigating its possibilities in this direction, the patent was tested on a small laboratory scale.

Hydrogen and carbon monoxide, prepared and purified by the usual methods, were mixed in the proportions required by the equation:—



with pure compressed nitrogen from a cylinder, and the mixture bubbled through ammonia-free water at 65° C. In this way, the gases were saturated with water vapour, which at this temperature exerts a pressure of 190 mms. The mixture was then passed through the catalyst chamber, consisting of an ordinary Liebig's condenser tube enclosed in a steam jacket. The gases then attained a temperature of 100° C., and the partial pressure of the water vapour would be that demanded by the above equation. The catalyst employed was freshly prepared platinised asbestos. On their exit, the gases were bubbled through ammonia-free water. In all, about 13 litres of the mixture were passed slowly through the apparatus, but in spite of the fact that a favourable temperature was employed there was no appreciable production of ammonium formate; no precipitate was given with either Nessler's solution or with silver nitrate. One is forced, therefore, to the conclusion that, even on the laboratory scale, the process is quite useless. This, after all, is to be expected, since the patent is based on the false and obsolete doctrine of "Predisposing Affinity" (see Ostwald, "Lehrbuch," II., 2, p. 30). The process, however, is often quoted in the literature (see, for example, Knox: "Fixation of Nitrogen," 1921, p. 83, and Stewart: "Recent Advances in Physical and Inorganic Chemistry," 1920, p. 25).

I wish to thank Prof. Partington for suggesting this investigation.

IRON FOUNDING AND RESEARCH.

The Duke of York has promised to visit the Foundry Trades Exhibition, which is to be held at Bingley Hall, Birmingham, on June 20-23. It has been organised by the Institution of British Foundrymen, which will then be meeting in conference in Birmingham, and simultaneously the Institution of Automobile Engineers and the Municipal Electrical Association will also be holding conferences in Birmingham. The British Cast Iron Research Association is largely interested in the Foundry Trades Exhibition (of which Lord Weir is President), this being the first of its kind held in Europe. The Institution of British Foundrymen was founded in 1903 in Birmingham (which possesses more foundries in its area, 118, than any other English town or city), and has over 2,000 members. The largest single county foundry area is Yorkshire, with 408. There are nearly 3,000 iron foundries in Great Britain and Ireland, and these are divided as follows: England: North Counties (Northumberland, Cumberland, Durham, Westmoreland, Lancashire, Yorkshire), 881; Midland Counties (Staffs., Worcestershire, Warwickshire., Leicester, Derbyshire, Notts., Northamptonshire), 828; West Counties (Wales 81, Chester, Salop, Hereford, Monmouth, Gloucester, Somerset, Devon, Cornwall), 321; East Counties (Lincoln, Norfolk, Cambridge, Hunts., Suffolk, Essex, Beds., Bucks., Herts.), 174; South Counties (Berkshire, Wilts, Dorset, Hants., Sussex, Surrey, Kent, Middlesex, Oxford), 137; London, 98; Scotland, 305; and Ireland, 52.

The cast iron trade has been singularly lacking in the application of science to the industry, and the new movement, which is intended to repair the deficiency, has the support of large numbers of leading industrial chemists and metallurgists. This effort to bring science into closer relationship with the industry is the outcome of our war experiences, when the best brains of the country and the resources of the laboratory were called upon either to expedite production. To stimulate effort in repairing deficiencies which had become painfully manifest, the Government placed a fund of a million sterling at the disposal of the Research Dept., and the hope is entertained that by means of a bureau of technical data and the laboratory the malleable cast iron trade may become up-to-date and more scientifically conducted. The situation in this respect certainly shows some improvement already.

POLYMERISATION.

To the Editor of the "Chemical News."

Fleetwood, April 22.

SIR, I shall be glad if you will allow me to correct two printer's mistakes which have crept into my article on "Polymerisation at the Critical Temperature."

(1) For $T_c \propto p \propto s = 22.15$

R_T

read $\frac{T_c p s}{R_T} = 22.15$

R_T

(2) The formula I suggested for Van der Waal's was

$$\left(P + \frac{a}{v^2} \right) \left(v - \frac{b}{\sqrt{p}} \right) = RT.$$

Yours truly,

W. R. FIELDING.

NOTES ON BOOKS.

Organic Analysis, qualitative and quantitative, by E. DE BARRY BARNETT, B. Sc., F.I.C., and P. C. L. THORNE, M.A., A.I.C. Pp. XII. + 168. London: University of London Press, Ltd., 17, Warwick Square, E.C.4. 1921. Price 7s. 6d.

This book is intended as a companion to the works on the preparation of organic compounds.

In the part dealing with qualitative analysis, the authors lay stress on the systematic detection of groups, and do not attempt to devise a scheme for the identification of every organic substance. The usual analytical procedure is given—tests for elements, separation into classes, identification by properties. The latter sometimes receive scanty mention, but the student is advised and encouraged to consult Richter's *Lexikon* and Beilstein's *Handbuch*. To this end an appendix indicates the way to use these works of reference.

Instructions for conducting quantitative analyses are given in Part II., together with the Physical and Chemical methods for determining molecular weights. The Estimation of Groups and individual substances receives especially good treatment, and in the early chapters, due importance is attached to the determination of physical constants, including refractive indices.

The methods selected and the apparatus figured are generally the best, but this cannot be said of the ancient combustion furnace on p. 76.

The book should prove useful to students reading for University examinations, or those of the Institute of Chemistry.

J. G. F. D.

Coal Tars and Their Derivatives, by Dr. G. MALATESTA, translated from the first Italian edition, with revisions, corrections and additions by the author. Pp. XII. + 530. London: E. and F. N. Spon, Ltd., 1920. Price 21s. net.

In translating his Italian treatise on the production of tar, Dr. Malatesta has taken the opportunity to revise it and make additions.

This industry has now attained colossal dimensions, as evidenced by statistics of the production and exports of various countries.

Part I. is historical. It details the various manufacturing processes and plant.

Tars formed by distilling oils, lignite, peat, and wood are also described.

A brief account of the individual constituents and their uses concludes this section.

Part II. deals with the distillation and fractionation of tar and the rectification of the various "oils," together with the manufacture of pitch, asphalt and bitumen.

Part III. gives the analytical methods adopted.

The book contains many useful tables, and is fully illustrated with very good diagrams. The wording of those on pages 141-143 is in Italian, and in the next edition the author could give the usual synonyms on page 262. C_7H_{16} should be Heptane, not Eptane. A few other obvious errors appear.

It seemed necessary to notice these small defects, which, however, scarcely detract from the unquestionable value of this work, which will be widely read in industrial circles.

J. G. F. D.

The Principles of Symmetry and its applications in all Natural Sciences, by F. M. JAEGER, Ph.D. Second, augmented edition. Pp. XII. + 348. Amsterdam: "Elsevier" Publishing Company, 1920.

This book, dedicated to Sir W. J. Pope, is of a most unusual character, and originated in a series of lectures by the author, whose purpose is to draw attention to a principle, the significance of which, in biological morphology, and especially in physics and chemistry, is becoming more and more apparent.

The general doctrine of symmetry and its laws are confined to four chapters. The tendency towards symmetry is one of the great natural laws, and is an instance of the general scheme towards stability. The laws of symmetry apply not only to inorganic crystals, but to phenomena in the animal kingdom and to floral structures. Some botanists will not agree with the author's inclusion of phyllotaxis as an exemplification of his theories.

An adequate and correlated account of the achievements of many investigators in different fields is given, and includes those of Pope and Kipping on the asymmetric atoms of elements of valency greater than 2, and the theories of Van't Hoff and Le Bel. It also includes the work of Brevais, Sohneke, Schönflies, Fedorov, Barlow and others. Not least among these are his own contributions to our knowledge on this subject.

From Pasteur's resolution of racemic acid into two optically active compounds the development of this subject is treated in detail.

Werner's work on the optical activity of complex inorganic compounds is reviewed, and the improbability of some of his conclusions is indicated.

There are copious references to the literature, and surprisingly few errors occur. The illustrations are clear and good, and the English is remarkably good. This very inspiring book should receive the careful attention of investigators in many diverse fields.

J. G. F. D.

Inorganic Chemistry, by T. MARTIN LOWRY, C.B.E., M.A., D.Sc., F.R.S. Pp. X. + 943. London: Macmillan and Co., Ltd., 1922. Price 28s. net.

The boundaries of the various branches of Chemistry are gradually becoming less recognisable. This is largely due to the advances made in Physical Chemistry, and is most noticeable in Inorganic Chemistry.

Prof. Lowry has indicated the importance of a complete understanding of Physical Chemistry in studying the Inorganic branch of the science. The first part of his treatise is largely historical, and the fundamental chemical theories are introduced in a logical manner. Part II. gives a very full account of the preparation, properties, compounds and uses of the non-metals.

Parts III. and IV. deal respectively with the "Typical" and "Transitional" series of metals, following Mendeléeff's classifica-

tion. The chapter on the Classification of the Elements incorporates all important modern conclusions, and is especially good. The author might have emphasised, however, that less significance is now attached to Lothar Meyer's Atomic Volume curves.

Equilibrium diagrams have been freely used, particularly in the study of alloys. Important industrial operations are carefully described, and the illustrations of crystals and apparatus are also particularly good.

An account of the natural silicates is given, indicating their importance in mineral chemistry, and special chapters are devoted to the Structure of Crystals, the Radioactive Elements, Isotopes, Photography, etc.

Tables of the elements appropriately include the Atomic Numbers as well as Atomic Weights.

Very few errors have been noticed, the most serious being that H.SnO.ONa is termed *sodium stannate* on p. 686.

Altogether this is a very suitable textbook for students, and will doubtless be consulted and freely used by more experienced chemists.

J. G. F. D.

Exploitation du Pétrole par Puits et Galeries, par Paul de Chambrier, Directeur général des Mines de Pêchebrenn, Chargé d'un cours libre à l'Université de Strasbourg; pp. 106 + map. Paris: Dunod, Editeur, 1921. Price 5fr.

The success which has attended the tests on the exploitation of petroleum at Pêchebrenn in Alsace, by systems of wells and galleries has prompted M. de Chambrier to make them permanently available. He hopes that others will thereby be encouraged to adopt these methods, particularly in those oilfields where the yield of crude oil could be increased. Methods of working and general statistics are given which enable a comparison to be made between the yields obtained by the methods used in the United States and those of Alsace.

A theoretical explanation is put forward of the oozing of oil in the drainage galleries together with a new process of estimating reserves.

The book, which is also a summary of the author's lectures at the University of Strasbourg, is certainly worthy of the careful consideration of technologists engaged in this branch of applied science. J.G.F.D.



New Patents.

This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 9564—Adair, W. G. Chemical reduction of organic compounds, etc. April 3.
 9765—Carmichael & Co., Ltd., J. E. Means for elevating and controlling supply of acids, etc. April 5.
 9681—Chemical Engineering Co., Ltd. Processes for producing intimate mixtures of substances and for obtaining chemical products therefrom. April 5.
 9828—Dutt, E. E. Process for extraction of titanium dioxide and vanadium salts from bauxite. April 6.
 9792—Green, A. G. Preparation of azo-compounds. April 5.
 9734—Loying, F. H. Method of refining metals. April 5.

Specifications Published this Week.

- 177189—Dixons, H. Manufacture of alkyl sulphates.
 158946—Muckka, J. Preparation of inert gas mixture of nitrogen and carbon dioxide by means of internal combustion engines.
 168578—Emery, V. L. Processes and apparatuses for the conversion of hydrocarbon oils.
 156177—Trauns Forschungslaboratorium Ges., H.O. Process for the manufacture of hexamethylene tetramine and formaldehyde.
 155735—Stockholm Superfosfat Fabriks Aktiebolag. Method of manufacturing acetaldehyde from acetylene.
 177340—British Cellulose & Chemical Manufacturing Co., Ltd. Manufacturing of pyrosulphates.

Abstract Published this Week.

Potassium Chloride. Patent No. 175,348.—A method of obtaining Potassium Chloride has been devised by Mr. G. A. Blanc, of 56, Via Via Fontanella di Barghese, and E. Jourdan, of 186, Via del Babuino, both in Rome.

Rocks containing potash, such as leucite, are treated in counter-current in a furnace with gaseous hydrochloric acid, the temperature being about 600° C. at the outlet, 200° C. at the inlet end. The chlorides other than alkali chlorides are decomposed by the time the material reaches the outlet end, and the chlorides are leached out from the product. The hydrochloric acid may be produced by the Hargreaves process, using the potassium chloride produced by the main process, the hydrochloric acid being used directly in the hot state.

Messrs. Rayner & Co. will obtain printed copies of the published specifications and forward on post free for the official price of 1s. each.

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PATENTS AND DESIGNS ACTS, 1907
 AND 1919.

PHENOL PRODUCTS.

THE PROPRIETOR of British Letters Patent No. 9291, of 1914, is prepared to sell the Patent or to license British Manufacturers to work under it. It relates to an improved method of manufacturing condensation products of phenol and substances containing the methylene radical.

Address:— B. W. & T.,

111 & 112, Hatton Garden,

London, E.C.1.

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3239.

NATIONAL ALLIANCE OF EMPLOYERS AND EMPLOYED.

INDUSTRIAL PARLIAMENT.

Having regard to the widespread interest which is being taken in the idea of forming some joint organisation representative of Employers and Employed, by way of an Industrial Parliament or otherwise, it may be useful to give an idea of the experience and success of the National Alliance of Employers and Employed in attempting a similar object.

It has probably been the experience of all who have attempted pioneer work in Industrial or Trade Organisation that the leaders in the earlier stages must be individuals working as such. Until substantial progress has been made the official support of other organisations is difficult to secure. At the same time, it is certain that no joint organisation can be really effective unless it is founded on a representative basis, that is to say, on a basis of Employers' Associations and Trade Unions or branch Trade Unions represented on the administrative committees of the joint organisation by their duly-authorised nominees.

The Alliance has now passed through the first or individualistic stage, and the next few weeks will see its new representative Constitution an accomplished fact.

CONSTITUTION OF NATIONAL ALLIANCE OF EMPLOYERS AND EMPLOYED.

MEMBERSHIP.

The Alliance shall consist of:—

1.—Full Members.

(a) Employers' Associations, Companies or Firms.

(b) Trade Unions or Federations of Trade Unions.

2.—Associate Members.

Persons in sympathy with the objects of the Alliance and approved by the National Executive Committee or by the Area Committee of the locality in which they reside.

ADMINISTRATION.

The affairs of the Alliance shall be conducted by:—

1.—A General Meeting of Members.

2.—A General Council.

The General Council shall consist of:—

(a) One Employer and one Trade Unionist from each Area Committee.

(b) Two members from each affiliated Employers' Association and Trade Union.

(c) Associate members co-opted by the General Council to a number not exceeding 25 per cent. of the total strength of the General Council.

In making such co-option the General Council may take into consideration any nomination received from the National Executive Committee or Area Committees.

This General Council shall be equally balanced of Employers and Employed, Class (c) to be drawn upon when necessary to maintain the balance. Members under Sections (a) and (b) shall elect annually a National Executive Committee not exceeding forty in number. The General Council may delegate such functions and powers as they may determine to the National Executive Committee, Area Committees and any other Committees which it may appoint. The General Council shall meet not less than three times a year to receive reports from their National Executive Committee, and give general directions as to the policy to be pursued by the Alliance.

3.—The National Executive Committee.

The National Executive Committee shall not exceed forty in number. Half its members shall be composed of and elected by members of Section (a) of the General Council, and the other half shall be composed of and elected by members of Section (b).

4. Area Committees.

An Area Committee may be elected by the members of the Alliance in any area, the boundaries of such area being defined by the General Council. Such Committees shall comprise the following:—

(a) EMPLOYERS. — Representatives of local Employers' organisations and individual firms.

(b) TRADE UNIONS. — Representatives of local Trade Union branches and any other bona fide Labour organisations.

(c) ASSOCIATES. — Any individual who is not a representative under Classes (a) and (b) and is co-opted by the Area Committee.

5.—On all Committees Employers and Employed shall be represented in equal numbers.

The Labour side of the Alliance Executive includes delegates from the following National Trade Unions—

General Federation of Trade Unions.
The Shipping Guild.
National Sailors' and Firemen's Union.
Workers' Union.
Iron and Steel Trades Confederation.
Coal Trimmers' Union.
Steel Smelters.
Amalgamated Society of Felt Hatters.
Anchorsmiths and Shacklemakers.
Dockers' Union.

In the Provinces over 2,000 (two thousand) Trade Union Branches have officially declared themselves in support of the principles and methods of the National Alliance of Employers and Employed. This number includes the following:—

Class of Craft or Industry.	Branches.
Agriculture	50
Bakers and Confectioners	49
Boots, Shoes and Leather	61
Building Trades	160
Clerical	92
Coal-mining	42
Distributive Trades	57
Engineering	201
General Workers	346
Glass Workers	28
Metal Industries	156
Printing Trade	83
Teaching Profession	49
Textile	109
Transport (including Railways) ...	175
Miscellaneous	200
also 13 Trades and Labour Councils	(approx.) 260
	2,118

The Employers' Federation represented officially upon the Executive of the Alliance include the

Federation of British Industries.
The National Federation of Iron and Steel Manufacturers.
Brassfounders' Employers' Association.
Associated Chambers of Commerce.
Inc. Federated Association of Boot & Shoe Manufacturers.
Central Landowners' Association.

and in addition representatives of local Associations and Federations of Employers and Chambers of Commerce throughout all districts where Area Committees of the Alliance are formed.

62, Victoria St., S.W., 2nd May, 1922.

PROCEEDINGS AND NOTICES OF SOCIETIES.

ROYAL SOCIETY.

LIST OF PAPERS READ ON MAY 11TH, 1922.

Lord Rayleigh, F.R.S. A Photographic Spectrum of the Aurora of May 13th-15th, 1921, and Laboratory Studies in connection with it.

Lord Rayleigh, F.R.S.—A Study of the Presence or Absence of Nitrogen Bands in the Auroral Spectrum.

C. Chree, Sc.D., F.R.S.—The 27-day Period (Interval) in Terrestrial Magnetism.

M. Barker.—On the use of very small Pitot-tubes for measuring Wind Velocity. Communicated by Mr. G. I. Taylor, F.R.S.

E. T. Paris.—On Doubly-resonated Hot-wire Microphones. Communicated by Prof. H. L. Callendar, F.R.S.

Prof. J. C. McLennan, F.R.S., and D. S. Ainslie.—On the Structure of the Line of Wavelength = 6708 A.U. of the Isotopes of Lithium.

At 4 p.m.—Election of Fellows.

THURSDAY, MAY 4TH, 1922, AT 4.30 P.M.

PAPERS TO BE READ:

C. Shearer, F.R.S.—On the Heat Production and Oxidation Processes of the Echinoderm Egg during Fertilisation and Early Development.

Johan Hjort, For. Mem. R.S.—Observations on the Distribution of Fat-soluble Vitamines in Marine Animals and Plants.

H. Hartridge and R. A. Peters.—Interfacial Tension and Hydrogen Ion Concentration. Communicated by Mr. W. B. Hardy, Sec. R.S.

W. Cramer, A. H. Drew, and J. C. Mottram.—Blood-platelets and their Behaviour in "Vitamin A" Deficiency, and after "Radiation"; and their Relation to Bacterial Infections. Communicated by Prof. W. Bulloch, F.R.S.

It is usually possible for a Fellow to obtain an abstract of a paper in which he is interested, by application to the Assistant Secretary a day or two in advance.

At the meeting of June 1, the Croonian Lecture will be delivered by Prof. T. H. Morgan, of Columbia University, on "The Mechanism of Heredity."

ROYAL INSTITUTION.

The Annual Meeting of the members of the Royal Institution was held on Monday, the 1st of May, Sir James Reid, Bart, Vice-

President, in the chair. The Annual Report of the Committee of Visitors for the year 1921, testifying to the efficient management of the Institution, was read and adopted. The Report of the Davy Faraday Research Laboratory Committee was read. Fifty-seven new members were elected in 1921, and 63 lectures and 19 Evening Discourses were delivered. The books and pamphlets presented amounted to about 210 volumes, making with 441 volumes (including periodicals bound) purchased by the managers, a total of 651 volumes added to the Library in the year. Thanks were voted to the President, Treasurer and Secretary, to the Committees of Managers and Visitors, and to the Professors for their valuable services during the past year. The following gentlemen were unanimously elected as officers for the ensuing year:—

President, the Duke of Northumberland; treasurer, Sir James Crichton-Browne; Secretary, Col. E. H. Grove-Hills; managers, S. G. Brown, Dr. J. Mitchell Bruce, A. H. Goschen., Sir Alexander C. Mackenzie, Sir Ernest Moon, The Hon. Sir Charles Parsons, Dr. Alfred W. Porter, Sir James Reid, Bart., the Marquess of Salisbury, K.G., Sir David Salomons, Bart., Joseph Shaw, William Stone, Sir J. J. Thomson, O.M., Sir Almroth Wright, the Right Hon. Lord Justice Younger; Visitors, J. H. Batty, Dr. W. A. Bone, Alfred Carpmæl, Dr. E. Clarke, Sigismund Goetze, G. H. Griffin, Dr. J. R. Leeson, Sir Oliver Lodge, P. A. Molteno, Sir Malcolm Morris, Richard Pearce, H. M. Ross, Sidney Skinner, T. H. Sowerby, William A. Tait.

On Saturday next, May 13th, at 3 p.m., Professor O. W. Richardson, D.Sc., F.R.S., will lecture on:—

The Disappearing Gap between the X-ray and the Ultra-Violet Spectra: (1) *Grating Results*.

THE MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

The following officers and members of Council were elected at the Annual General Meeting of the Manchester Literary and Philosophical Society on Tuesday, April 25th, 1922:—

President, T. A. Coward, M.Sc., F.Z.S., F.E.S.; Vice-Presidents, Sir Henry A. Miers, M.A., D.Ss., F.R.S., W. Henry Todd, Arthur Lapworth, D.Sc., F.R.S., F.I.C., C. E. Stromeyer, O.B.E.,

M.Inst.C.E.; Secretaries, H. F. Coward, D.Sc., F.I.C., Prof. T. H. Pear, M.A., B.Sc.; Treasurer, R. H. Clayton, B.Sc.; Librarians, C. L. Barnes, M.A., Wilfrid Robinson, D.Sc.; Curator, Prof. W. W. Haldane Gee, B.Sc., M.Sc.Tech.; *Other Members of the Council, W. M. Tattersall, D.Sc., Prof. F. E. Weiss, D.Sc., F.R.S., F.L.S., Francis Jones, M.Sc., F.R.S.E., F.C.S., Miss Laura Start, M.Ed., Prof. Sydney Chapman, M.A., D.Sc., F.R.S., Prof. W. L. Bragg, M.A., F.R.S., the Rev. A. L. Cortie, S.J., F.R.A.S., F.Inst.P., R. L. Taylor, F.C.S., F.I.C., William Thomson, F.R.S.E., F.C.S., F.I.C. (*Ex-officio, The Chairman and the Secretary of the Chemical Section.

THE INSTITUTE OF METALS.

Westminster, S.W.1, 2 May, 1922.

THE RELATION OF THE ELEMENTS.

LECTURE BY SIR ERNEST RUTHERFORD.

Professor Sir Ernest Rutherford, F.R.S., delivered the twelfth annual May Lecture to a crowded meeting of members of the Institute of Metals on Wednesday, May 3, at the Institution of Mechanical Engineers, Westminster. Mr. Leonard Sumner, M.Sc., President of the Institute, was in the chair, and was accompanied on the platform by officers of the Institute, including Professor H. C. H. Carpenter, F.R.S. (past President); Sir John Dewrance, K.B.E. (Vice-President); Dr. W. Rosenhain, F.R.S. (Vice-President); Professor T. Turner, M.Sc. (Vice-President); Mr. L. Archbutt (Member of Council); Dr. H. W. Brownson, M.Sc. (Member of Council); Engineer Rear-Admiral R. B. Dixon, C.B. (Member of Council); Professor C. A. Edwards, D.Sc. (Member of Council); Dr. R. S. Hutton (Member of Council); Mr. F. C. A. H. Lantsberry, M.Sc.Tech. (Member of Council); Mr. W. Murray Morrison (Member of Council); Mr. H. A. Ruck-Keene (Member of Council); Mr. A. E. Seaton (Member of Council); Dr. R. Seligman (Member of Council); Mr. F. Tomlinson (Member of Council); Mr. H. B. Weeks (Member of Council); and Mr. G. Shaw Scott, M.Sc. (Secretary).

Sir Ernest Rutherford said that very rapid strides in the growth of our knowledge of the constitution and relation of the elements has been made in the last decade.

It had become clear that the atoms were electrical structures of the same general type, consisting of a minute but massive charged nucleus surrounded at a distance by a distribution of negative electrons. The work of Moseley had shown that an unexpectedly simple relation existed between the elements. Apart from its mass, the properties of an element were defined by a whole number which represented the charge on the nucleus and the number of the outer electrons. This number also gave the ordinal or atomic number of the element arranged in order of increasing weight. All the known elements were defined by numbers starting from 1 for hydrogen and ending at 92 for uranium, and only a few numbers were missing. The discussion of the structure divided itself into two parts, one the laws controlling the position and movements of the outer electrons, and the other the constitution of the nucleus. After reference to the recent remarkable theories of Bohr to explain the distribution and motion of the electrons and the origin of the periodic variation of the properties of the elements, attention was directed to the structure of the nucleus which was of great complexity in heavy elements. The evidence derived from a study of the disintegration of the radioactive elements showed that the nucleus contained both helium nuclei and electrons, but no sign of the emission of hydrogen nuclei had been observed.

The atoms of the elements were very stable structures, and in order to break them up it was necessary to use concentrated sources of energy to overcome the powerful forces holding the nuclei together. The most suitable agent for attack was the swift alpha particle from radium. The atoms were bombarded by a stream of alpha particles, and occasionally one of the latter passed close enough to a nucleus to effect its disruption. Experiments made by Dr. Chadwick and the speaker showed that in this way swift hydrogen nuclei were liberated from the atoms of nitrogen, fluorine, sodium, phosphorus and aluminium, but the amount of disintegration was on a very minute scale.

It seemed clear that hydrogen nuclei were constituents of the nuclei of these atoms, and were in all probability satellites of the main system. It was believed that the helium nucleus was a secondary structure built up of 4 hydrogen nuclei, and that

consequently the nuclei of all elements consisted ultimately of an ordered structure of hydrogen nuclei and electrons. The arrangement of the parts composing the nucleus and the forces operative were quite unknown, and the difficulties of direct attack on this problem of nucleus structure were very great.

The meeting concluded with a vote of thanks to Sir Ernest Rutherford, proposed by the Chairman and seconded by Dr. W. Rosenhain, F.R.S.

BIRMINGHAM & MIDLAND SOCIETY OF CHEMICAL INDUSTRY.

A STUDY IN MODERN AGRICULTURAL SCIENCE.

A joint meeting of the Birmingham and Midland Society of Chemical Industry and the Institute of Brewing was held at the Birmingham University on Thursday, 4th May. There was a large attendance, and Professor Ling presided, Dr. Brownson (Society of Chemical Industry) supporting him. Dr. E. J. Russell, of the Rothamsted Agricultural Research Station, spoke on Agricultural Chemistry in relation to Barley. He said that fortunately the farsighted action of the Institute of Brewing in setting up a research scheme had made it possible to begin a close investigation of the relationship between malting quantity and agricultural conditions. Plots had been laid out on a number of good barley farms in good barley districts, and they were treated in accordance with the following scheme: (1) No manure; (2) complete artificials: 1 cwt. sulphate of ammonia, 3 cwt. superphosphate, $1\frac{1}{2}$ cwt. sulphate of potash per acre; (3) artificials without potash: 1 cwt. sulphate of ammonia, 3 cwt. superphosphate; (4) artificials without phosphate: $1\frac{1}{2}$ cwt. sulphate of potash, 1 cwt. sulphate of ammonia; (5) artificials without nitrogen: 3 cwt. superphosphate, $1\frac{1}{2}$ cwt. sulphate of potash. The yield would be recorded, and the resulting samples of barley would be fully examined by a competent malting chemist for the following properties: Empirical valuation of barley, determination of nitrogen and moisture, 1,000 corn weight, Blaber cupboard process of malting, full analysis of the extract of resulting malting samples. The results would give information of great value on the effect of fertilisers on the yield and quality of barley, and in particular they hoped they would settle a vitally important agricultural prob-

lem—whether the farmer, if he manured properly, could safely aim at the highest crop that would stand up, or whether he must aim at something less, if he wished to maintain a high quality. They could go a long way towards settling this difficult matter of manuring barley. Again, it would be a distinct step if they could prove, what was generally accepted, that good malting quality was the same thing as favourable growth and maturation in the second part of the plant's life; it was hoped also to study the effect of variety on malting quality, and thus be able to advise farmers which of the different varieties now existing or to be produced in the future would prove best for them and for the maltster; and finally, they hoped to make an attack on that difficult problem—the chemical characterisation of a good malting barley. The Brewing Research scheme had justified itself, in that for the first time it had set up a co-operation between the maltster, the barley grower, the expert malt and brewing chemists, and the expert in agricultural science.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

ORDINARY MEETING, 3RD MAY, 1922.

Held at the Chemical Society's Rooms, Burlington House, Mr. P. A. Ellis Richards (President) in the chair.

Certificates were read for the first time in favour of:—Messrs. Archibald Steele Whamond, Thomas John Ward.

A Certificate was read for the second time in favour of:—Mr. Frederick Major, B.Sc. (Lond.), A.I.C.

The following were elected Members of the Society:—Messrs. William John Agnew, B.A. (R.U.I.), Arthur Thomas Etheridge, M.B.E., B.Sc. (Lond.), F.I.C., Reginald Ernest Essery, B.Sc. (Bristol), A.I.C., George Girvan Herbert, A.I.C., George Lewis Hutchison, B.Sc. (Lond.), F.I.C.

The following papers were read:—

“Studies in the Titration of Acids and Bases,” by J. L. Lizius, B.Sc., A.I.C., and Norman Evers, B.Sc., F.I.C.

“Graphites and other Pencil Pigments,” by C. Ainsworth Mitchell, M.A., F.I.C.

“The Sulphuric Acid Reaction for Liver Oils and its Significance,” by J. C. Drummond, D.Sc., F.I.C.

“Inadequacy of ‘A.H.’ Test for Alkalies in Calcium Carbonate,” by W. Singleton and H. Williams.

ABSTRACT.

“Studies in the Titration of Acids and Bases,” by J. L. Lizius, B.Sc., A.I.C., and Norman Evers, B.Sc., F.I.C.

The application of the newer indicators to the ordinary titrations of acids and bases has been studied, and new indicators or combinations of indicators are recommended, giving sharp colour changes at the end-point and greater accuracy of results than the indicators commonly in use. Methods of determining the hydrogen ion concentration of the true end-point of a titration are described, and a table of titrations is given showing the hydrogen ion concentration of the end-point, the best indicator, the sharpness of the end-point, and the accuracy to which results may be obtained.

ABSTRACT.

“Graphites and other Pencil Pigments,” by C. Ainsworth Mitchell, M.A., F.I.C.

Further details are given of the author's microscopical method of examining graphites, the results being compared with the chemical composition of various graphites and pencil pigments (old and modern), including a specimen of graphite from Egypt (B.C. 1500). Analyses are also given of the pigments in typical coloured pencils, and their differentiation in markings on paper are discussed.

ABSTRACT.

“Inadequacy of ‘A.R.’ Test for Alkalies in Calcium Carbonate,” by W. Singleton and H. Williams.

The authors find that the “A.R.” method for determining alkalies in calcium carbonate is inadequate, and requires revision, as in several samples of “A.R.” quality they find that only about 10 per cent. of the total alkalies present in the calcium carbonate are removed by one extraction with distilled water according to the “A.R.” method. Even after five extractions of the substance with water, only about 15 per cent. of the total alkalies present were removed, and only about half the total of five extractions is removed by the first treatment.

ABSTRACT.

“The sulphuric Acid Reaction for Liver Oils, and its Significance,” by J. C. Drummond, D.Sc., F.I.C.

The chromogenic substance giving the characteristic colour reaction appears to be a normal constituent of the liver, the

author having found it present in the liver of man and twenty-one other animals. It seems to have a distinct relationship to Vitamin A, for example a number of samples of cod liver oil of known purity, classified according to intensity of their colour reactions with sulphuric acid, were found to be also classified in the order of their Vitamin A content. The colour reaction is correspondingly feeble for oils obtained from animals deprived of Vitamin A. Attempts to trace the origin of the chromogenic substance in the food of the cod failed. The few properties of the substance which are known, as well as the available data regarding its distribution, show certain resemblances to the unidentified Vitamin A. Without assuming the identity of the two factors, the author suggests that the association may be of significance.

THE SOCIETY OF DYERS AND COLOURISTS.

The Annual Meeting of the Society was held at the Midland Hotel, Manchester, on Friday, 31st March, 1922, the President (Mr. H. Sutcliffe Smith) in the chair.

In presenting the 28th Annual Report, for the year 1921, the Council is again pleased to be able to record continued progress in the work of the Society.

Twenty-seven original papers (surpassing all previous records) were read before the various Sections of the Society, and published in the *Journal* during 1921. Six original communications were also published.

These 33 papers cover a wide range of scientific and technical subjects, and indicate that both the most advanced theory and the most detailed practical descriptions are alike of interest and value to members of the Society. Sixteen of the papers may be described as chiefly on the practical side, seven as mainly dealing with testing and analysis, seven as mainly chemical, and three as theoretical.

The Annual Meeting and Dinner was held on Friday, March 18th, 1921, at the Great Northern Hotel, Bradford, at which function the presentation of a Perkin Medal was made to Mr. Horace A. Lowe "For the Production of a Permanent Lustre on Cotton."

The Medal of the Worshipful Company of Dyers, London, for the period July, 1919, to June, 1920, has been awarded to Dr. A. E. Everest, and a Diploma has been presented to Mr. A. J. Hall as co-author.

THE ANNUAL DINNER.

At the close of the Annual Meeting the Annual Dinner was held at the Midland Hotel, Manchester, Mr. H. Sutcliffe Smith, President of the Society, in the chair.

One hundred and seventy members and guests were present.

The President proposed the customary loyal toasts, which were duly honoured.

Sir Philip Lloyd-Greame, K.B.E., M.C., M.P., proposed the toast of "The Society of Dyers and Colourists." He said—Mr. President and Gentlemen: This Society which is, if I may so put it, the intelligence side of the great general staff of the industry, whether its members are the makers or the users of dyes, has a long and honourable history, and among scientific institutions of the country it holds, by right and by reputation, a very high place. I know something of the value of the work which it has undertaken in the past, and I understand that it now proposes to produce a complete Index, in the English language, of all commercial dyes. My acquaintance with the dye industry has not been very long, though it has been very intimate, and I already know enough to be sure that such a work should exist in the English language.

There seems to be hardly any field of enterprise into which dyes, directly or indirectly, are not likely to enter. Not only are they vital to the greatest industry of this country, the textile industry, not only have they proved to be of the most intense importance in time of war, but they are likely to be of still greater potential value should we be faced with war in the future. But it is not only in the military sphere, or in that wide commercial sphere, that dyes enter, and enter at a key point, but in an extraordinarily interesting address delivered in this city last night there has been opened up a new vista of the possibility of the medicinal value of dyes. The industry thus carries a great responsibility upon its shoulders, and a great future lies before it.

There is one aspect of this Society which seems to me to be one of great value and of great promise. In it both the makers and the users of dyes meet on a common ground to study common problems and to pursue a common purpose. It is the *raison d'être* of the existence of those who make the dyes that they should adequately supply the needs of those vast industries which use them, and surely there can be no better course than that the best scientific brains in all these industries should meet on common

ground such as this to develop their common problems, and to face their common difficulties.

The causes of our difficulties to-day lie in the fact of the poverty of the world resulting from the war. We have got now beyond the stage of visualising the wealth of the world on any artificial basis, and we know that the artificial prosperity experienced by many industries during the war came merely from mortgaging our resources—a necessary mortgage, and a mortgage which we were bound to give, but in every country of the world which was affected by the war, wealth was being spent in unproductive enterprise, and the wealth of the world was growing less. In the aftermath of the war, at the first, there was that sudden dectic boom, which was inevitable perhaps but profoundly unfortunate, because an impoverished world was still further mortgaging its resources at unduly high prices; and following on that, with its inevitable slump, we see that in many quarters the resources of the world are still being wasted in unproductive expenditure. That is the main basic cause of the difficulties in this country to-day, and until that cause is remedied the position can never become straight. It affects us everywhere. It affects those who live by our great export trade, in that the markets in which they sell their goods have the less capacity to buy directly. But the great mechanism of British commerce was not simply a mechanism of direct trade to and fro. It was far more complicated than that. It was a mechanism so complicated that I doubt whether one man in a thousand recognised all its inter-relations until with a crash, through the war, the whole machine was suddenly thrown out of joint, and because it ceased to run we saw its complexity. You find that to-day the markets which bought from you are unable to buy. Because Europe is unable to buy, India sends into Europe less than half of what she did before the war, and it was those very credits created by India in Europe that filled the workshops of Lancashire. That is the position. I am just trying to-night to talk the ordinary sound economic common sense that needs to be talked in every assembly, whether political or any other. The job of the statesman to-day, as I see it, is to create those conditions in which traders can carry on their trade. The most essential of those conditions are these. In the first place, the establishment of real

and lasting peace all over the world by the development of the real will to prove the possibility to peace and the means to peace right through the whole world; to bring the whole conception of the Washington Convention into a world-wide reality which will react through all the countries of the world. The world is nominally at peace to-day, or the larger part of it. But you still find colossal armaments in many countries whose exchanges have gone to ruin and who are utterly unable to support those armaments. You will find the justification of those armaments in the fact that the nations are uncertain as to whether some attack may not come upon them from one quarter or another. If you could halve those military budgets you could largely abolish the inflated note issues. Not only that, but you would then have the will to peace in those countries. You would have men setting their minds solidly to the work of reconstruction, and there is no way to build up the world except by the sweat of men's brows and the steady work of their brains. Peace is the first and the last essential, for with peace there is stability. Whether it is in statecraft, or in business, men want to know that when they enter upon an enterprise the course is clear right through to the end of that enterprise. That cannot be given by a hand-to-mouth settlement, nor a day-to-day settlement, but only by a finality on which men, whether politicians or business men, can base their policy through the years to come. Depreciated exchanges are not the cause of all these difficulties. They are the inevitable consequence of the positions which exist in the world to-day. Therefore, the two objects which any man who claims to be even a politician, much less a statesman, should put before him are peace and certainty in economic conditions. But there is one other duty not less important, and that is to disabuse the minds of men of fallacies which grow and grow from day to day. First, there is the fallacy that there is any short cut to prosperity and to the redemption of the world. Then there is what I may call the fallacy of exclusive nationalism. The world has got to learn that an exclusive nationalism is neither practical, not patriotic, nor does it pay. We know that in our industries there is a complete interdependence of one industry upon the other. For example, it is not practical business for a nation which has neither coal

nor iron, to try to become a great iron and steel producing country. The economic future of the world demands the co-operation of the nations. Another fallacy is seen in the amazing way that people talk about credit. They talk about the possibility of creating credit as if it was merely a form of outdoor relief. Credit in the long run really means that the investor has got to come in, and out of his savings make his investments. To talk about the artificial creation of credit to people who have neither the capacity nor the will to pay is perfectly impossible. If credit is to be created, the conditions which breed credit have got to be there, and the investor has to be drawn in. Finally, another fallacy that has got to be combated, is that anybody is able to buy from you unless at the same time he sells. Buying power means one thing and one thing only. It means that the man who buys from you is producing, and he is able to sell his commodities, and through the general interchange system of the world is able to buy from you.

Obvious as it all is, how completely alien these simple observations are from much of the thought, or at any rate from much of the action, which is found nationally and internationally to-day. If the Genoa Conference, in which I have great faith, is able to achieve this, and this alone—that the world is persuaded not only to see the obvious but to do the obvious, then it will have achieved a signal service which no other Conference has yet achieved.

I have to couple this toast with the name of a very distinguished man and an old friend of my own, Mr. Sutcliffe Smith. There is no man who has rendered industry better service. I remember the service which he rendered to the Colour Users' Association when he assumed the chairmanship of that body at a not too easy time. I remember his work as President of the Bradford Chamber of Commerce, and more recently as one who has achieved a commercial entente for his industry with the French people in Houbaix and Turcoing, and for which the French people have rendered him homage. I am not sure whether he or I have the greater claim to the complete reorganisation of export credits, but I am perfectly prepared to share on a fifty-fifty basis. I remember that to him is almost entirely attributable the establishment of an Austrian clearing office which is working effectively at the present time. He

is the kind of man that we want in what I may call non-political public life to-day, and that is the kind of public life that is most important.

The President, in responding to the toast, extended to Sir Philip Lloyd-Greame, on behalf of the Society, a most hearty welcome. He proceeded:—I am sure that in saying how much we appreciate his address we can extend at the same time a very hearty welcome to him to the Industrial North. His work at the Department of Overseas Trade has been magnificent, and is appreciated not only by us, but also by the whole of the British trading public. We have also many other distinguished men here to whom we extend the same hearty welcome.

I had considerable diffidence in taking the Presidency of this Society after such a very distinguished man as the late Lord Moulton, whose death was a great and irreplaceable loss to all of us. But I feel highly honoured at being President, and being also Chairman of the Colour Users' Association; in my dual capacity I get a bird's-eye view of the many-sided interests, both scientific and practical, of the great dye industry, and the vital trades of this country to which that industry is so closely allied, and which, for their very existence, depend upon it.

The Society of Dyers and Colourists was originally formed in March, 1884, and its objects are purely scientific and technical. Its Journal, first issued in 1885, is known all over the world, and is of recognised scientific value. The past year has been an exceedingly busy one for the Society; the membership has been largely increased, and many meetings have been held by the various sections of the Society.

In Manchester you have wisely taken a great step forward in your Cotton Research Association, the headquarters of which was opened by H.R.H. the Duke of York on Tuesday last at Didsbury. I hope the Lancashire cotton industry, by its help, will continue to prove to the world that its productions are unexcelled for excellence and value.

The great hope of the future for British industry is that we should keep advancing by the aid of research, scientific methods, and economic production, thus placing our goods on a higher plane. It is only by doing this that we shall be able to meet the fierce competition that we inevitably shall

have to face in the markets of the world. I claim that no body has been more indefatigable in research than our Society, and it has been well said by one research authority that "we have delivered the goods."

Our work has been much appreciated by the Department of Scientific and Industrial Research as is shown by the fact that from 1917—1920 inclusive, they have allotted to us £1,125, and for every £1 so allotted the Society has put down a similar amount, and also an additional £914, making a total of £3,164.

This sum, although much too small for such an important work, has been, may I say it, very wisely and economically expended. We have lately been informed by the Department, we believe much to their regret, that they cannot see their way to continue this grant owing to the fact that they have had to divert their funds largely to the big Research Associations.

Now, gentlemen, I should like to appeal to the Department to reconsider their decision. The work is so important, that I feel it would be a great mistake to allow the scientific brains we have in this Society to lie dormant as regards research for what is, after all, a very small sum of money.

I venture to suggest also that the big dye-manufacturing firms, who have had large grants for research from the Government, might consider diverting a little of this money to enable our Society to continue this much needed work. May I also appeal to the Research Associations to consider whether it would not be highly desirable in their own interests to support this Society?

Then I should like to refer to the enterprise, lately undertaken by our Society, of issuing a much wanted colour index. The whole trade, makers and users alike, have so far had to rely for any information on the structure and properties of dyes on the out-of-date German colour tables issued in 1914. Great progress has already been made with this index, thanks to the initial enthusiasm of Mr. Hickson, and the very able services of Dr. Rowe, the Editor of the Colour Index, and his colleagues, and it is hoped to issue the first part in June, followed monthly by another, the whole to be completed in about twelve monthly parts. More detail will be given than in the Schultz book, and after leaving out obsolete colours there will be at least two hundred more colours described than appear in that book. As it will be issued in English, the

previous difficulty of translating technical German will be obviated, and it is hoped to keep the book up-to-date by means of periodical supplements in the *Journal*.

This is a monumental work, which will prove of the most valuable service to the English-speaking world, and one upon which the Society can be heartily congratulated.

(To be Continued.)

CHEMICAL NOTICES FROM FOREIGN SOURCES

DETECTION OF FORMOL BY MEANS OF PHENOLS.—*B. Pfygl, G. Reif, and A. Hanner.*

—The alcoholic liquid in which methyl alcohol is supposed to be present is first oxidised with permanganate and filtered. If an alcoholic extract containing essential oils is under examination, the liquid is acidified with sulphuric acid, and distilled, and then infusorial earth is added, and the clear liquid is oxidised. Guaiacol is the best phenol to use for the test, a solution of 0.02 gr. in 10 cc. of concentrated sulphuric acid giving a red colouration with formol. 5 cc. of this solution are placed in a watch glass and about 0.1 cc. of the solution is to be tested is added, and the colouration appears if 0.5 per cent. of methyl alcohol is present. Apomorphine hydrochloride gives a characteristic precipitate with formol, and the reaction is as sensitive as that with guaiacol. — (*Chem. Zeit.* XLV., 1921, 1,220.)

MERCURY FULMINATE—*H. Rathsburg.*—Impure mercury fulminate is much less stable than the pure product, and contains various unsaturated impurities. The impure product reacts more or less with potassium permanganate in aqueous solution in presence of acid or normal sodium carbonate, caustic soda and sulphuric acid, and with iodine and bromine in aqueous or sulphuric acid solution, while with the pure substance no reaction occurs. The pure product can be kept at a temperature of 50-60° for six months without undergoing any change, or it may suffer a loss amounting to about 0.5 per cent., while the corresponding loss of the raw substance in the same circumstances may be as great as 7.6 per cent. The raw fulminate, when dissolved in 20 per cent. ammonia and reprecipitated with acetic acid, may give up to this solution as much as 3.2 per cent. of oxalic acid.—(*Ber. deut. chem. Gesellschaft*, LIV., 1921, 3,185.)

DETECTION OF ARSENIC IN SOME MEDICINAL CHEMICALS—*J. Cribier*.—It has frequently been pointed out that arsenic may be present in various pharmaceutical products, and although the quantity may seem to be very small, the ill-effects of repeated minute doses must not be forgotten. The author's method of detection of such small quantities, involving the use of developed mercuric paper (*Journ. de Pharm. et de Chim.*, XXIV., 1921, 141), has enabled him to determine the amounts present in a very large number of chemicals used in medicine. If antimony, iron, or bismuth is present it is necessary to precipitate the ammoniacal magnesium phosphate in presence of tartaric acid, to prevent the precipitation of the hydroxides of these three metals. The sulphuric acid solution of this precipitate, which contains all the arsenic, can then be used for the exact determination of the quantity present. The examination of some hundreds of products shows that appreciable quantities of arsenic may be present in compounds of iron and antimony, and one specimen of calcium phosphate contained a relatively large amount.—(*Journ. de Pharm. et de Chim.*, XXV., 1922, 337.)

METHOD OF PREPARATION OF CITRATE AND TARTRATE OF BISMUTH—*Dr. Fabrigue*.—To prepare bismuth citrate, the author dissolves 100 gr. of bismuth nitrate in 200 gr. of acetic acid, dilutes with 500 gr. of distilled water, and filters. A solution of 67 gr. of sodium citrate in 600 cc. of water is then added. The white precipitate thus formed is allowed to settle and then washed with alcohol till the latter gives no residue on evaporation. The citrate is then dried at about 60°. It is a white micro-crystalline powder, insoluble in water, alcohol, ether and dilute acids, but soluble in ammoniacal water, with formation of double salts. Litmus paper is tinged red with it. Bismuth citrate has probably the constitution of an emetic. Its acid function enables it to form double salts with ammonium, the alkalis and the alkaline carbonates. The author has not succeeded in preparing double salts with ammonium or sodium, only getting more or less basic compounds when bismuth citrate in suspension in water was neutralised with ammonia or soda, and evaporated. Solutions of the double citrate of bismuth and sodium can be obtained by adding a solution of soda to the citrate till it was exactly neutral, but such solutions must be used

at once, for they readily give a deposit of a basic salt. The addition of glycerine retards this decomposition, but does not prevent it. Bismuth tartrate can be prepared by an analogous method, using sodium tartrate instead of citrate. These compounds can be used for intra-muscular and possibly for intra-venous injections.—(*Journ. de Pharm. et de Chim.*, XXV., 1922, 341.)

GENERAL NOTES.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

EXAMINATIONS: APRIL, 1922.—PASS LIST.

The following candidates passed the examination for the Associateship (A.I.C.):

In General Chemistry: Byrne, Lawrence James Patrick, B.Sc. (Birm.), University of Birmingham; Gardener, Guy William Carr, King's College, London, and Sir John Cass Technical Institute; Illing, Edward Thomas, B.Sc. (Lond.), Birkbeck College; Jones, Hugh Trefor, B.Sc. (Wales), University College of Wales, Aberystwyth; Raynes, John Leonard, B.Sc. (Lond.), University College, Nottingham; Shadbolt, Frederick Stanley, Sir John Cass Technical Institute and Birkbeck College.

In Branch (d), Organic Chemistry: Naylor, Henry, Blackburn Municipal Technical College; Philip, Reginald John, Birmingham Municipal Technical School.

In Branch (g), the Chemical Technology of Sulphuric Acid and its By-Products: Sanders, Alexander, Royal Technical College, Glasgow.

The following Associates passed the examination for the Fellowship (F.I.C.):—

In Branch A, section II., Metallurgy: Hargreaves, Frank, A.R.S.M., D.I.C.

In Branch E, the Chemistry (including Microscopy) of Foods and Drugs and Water: Barnes, Arthur Chapman, B.Sc. (Manc.); Byles, John Edward, B.Sc. (Manc.).

DETERMINATION OF SALT IN PETROLEUM.

Editor of the Journal of Industrial and Engineering Chemistry:

In the paper on the subject of "Determination of Chloride in Petroleum," by Ralph R. Mathews I have noted with interest his scheme of separating salt water

by mixing acetone and water with the oil under examination.

In this laboratory we have for several years been estimating salt after burning off an oil. For rapid control we weigh from 10 to 20 g. of a fuel oil in a dry nickel dish of about 250 cc. capacity, and heat the dish and contents over a Bunsen gas flame. When the oil is fuming thickly, the gases over the dish are ignited with the Bunsen flame, and the heating is continued until the oil fumes burn out. The Bunsen flame is withdrawn for a minute, 75 cc. of water are added, and the mixture is boiled vigorously for a few minutes. The dish is cooled in a vessel of cold water until cool enough to handle, and the contents are filtered and washed several times with water, scrubbing out the dish. After the addition of a few drops of 1:10 potassium chromate solution, the filtrate and washings are titrated as usual with standard silver nitrate, and the results are calculated to NaCl.

There is left in the dish a mass of charred matter which, after sufficient washing, does not retain more than traces of salt, and need not be completely removed from the dish before another determination is made. The dish does not get to a red heat while the oil is burning off, and the charred mass provides a means of protecting NaCl from volatilising. The nickel dish is not used for any other work.

If the oil contains an abnormal quantity of salt, it foams and spatters badly, and a lower flame is used for the first part of the heating operation.

Our specification on fuel oil for use in open hearth and forge furnaces does not permit the presence of more than 0.25 per cent. of salt. However, it is only rarely that we have met with samples of oil running as high as 0.10 per cent. On the other hand, in composite samples from bunches of ten carloads we have never found a total absence of salt. GEORGE T. DOUGHERTY.

American Steel Foundries, Chicago,
Illinois, April 20, 1921.

[Reprinted from the *Journal of Industrial and Engineering Chemistry*, Vol. 14, No. 1, page 80. January, 1922.]

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

The report described below has been published by His Majesty's Stationery Office

for the Department of Scientific and Industrial Research. Copies, price 6s. 6d. (by post, 6s. 8½d.) may be obtained through any bookseller, or direct from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2.

ON THE ELECTRO-DEPOSITION OF IRON.

By W. E. Hughes, B.A. (Cantab), Late Chief Research Chemist, Electro-Metallurgical Committee, Ministry of Munitions.

In view of the extended use of electro-deposition of iron for many industrial purposes, the Department of Scientific and Industrial Research has considered it advisable to issue the present bulletin which embodies the results of research carried out by Mr. W. E. Hughes, with the assistance of grants made by the Department.

The contents of the report are arranged under the following headings:—

Introduction.

Division 1.—*Descriptive.*

General note on the description of the deposits.

Series I. On the effect of temperature.

Series II. On the effect of current density.

Series III. On the effect of mechanical movement.

Division 2.—*Theoretical.*

Introduction.

I. The crystallisation of substances in general.

II. Application to electro-deposited metal.

A consideration of the results of the experiments of the series I., II., and III. Some remarks on deposits (1) from other iron solutions; (2) of other metals. General conclusions.

III. Workshop application.

Appendix. — Bibliography comprising references to publications on:—

I. The electro-deposition of iron and phenomena connected therewith.

II. The properties of electrolytic iron.

III. Works of reference relating to the electro-deposition of iron.

The bibliography will be of use to those desiring general information upon the subject, as well as to research workers. The report is copiously illustrated by a number of microphotographs.

THE GERMAN DYE TRUST.

In the House of Commons on April 26, Major Mackenzie Wood asked the President of the Board of Trade whether his attention had been called to the reported alliance between *La Compagnie Nationale de Matières Colorantes et de Produits Chimiques*, the trading makers of dyes in France, and the *Interessin Gemeinschaft*, the German dye trust, under which the Germans had agreed to assist the French company and disclose their trade secrets in consideration of the French undertaking to confine their sales to France and its colonies and to hand over 50 per cent. of their profits to the German trust; whether this arrangement had been communicated to the Reparations Commission; and what effect, if any, it would have on the delivery of dyes under the reparation clauses of the Treaty?

Sir W. Mitchell-Thomson, Under-Secretary to the Board of Trade, replied: I have seen statements to the effect that some agreement has been made between the French Company mentioned and the *Interessin Gemeinschaft*, but I have no official information as to its precise nature, and I am not aware that it has been communicated to the Reparation Commission. It does not appear that any such private agreement can have any effect on the delivery of dyestuffs under the reparation clauses of the Treaty of Versailles.

Major M. Wood: Is not the export of dyes' formulæ equivalent to the export of dyes, and does not that have a bearing upon the reparation clauses of the Versailles Treaty?—Sir W. Mitchell-Thomson: No, sir. I do not think so.—Dr. Murray: Is the hon. gentleman aware of the fact that Italy is contemplating a similar arrangement?—Sir W. Mitchell-Thomson: No, sir. I am not aware of that.—Mr. Kiley: Is he aware that the British Cellulose Company, in which the Government have a substantial interest, propose to engage a German staff,—No answer was given.

NOTES ON BOOKS.

Petroleum, by SIR BOVERTON REDWOOD, BART. Fourth Edition, reset throughout. In 3 Vols. Vol. 1: pp. XXX. + 364. Vol. 2: pp. 365 - 740. Vol. 3: pp. 741 - 1,353. London:

Charles Griffin & Co., Ltd., 1922. Price £5 5s.

This complete treatise on Petroleum will remain for ever one of the classics of technological literature.

The present thoroughly revised edition is the latest authoritative word on the subject. His scientific attainments and unique experience and knowledge of petroleum technology place everything on this subject from the pen of Sir Boverton Redwood on a very high level. But this edition also embodies the work of many other experts and specialists in various branches. This work thus becomes a most valuable encyclopædia on Petroleum.

Chemical research has extended our knowledge of the composition of the different mineral oils. The development of colloid chemistry has helped in the elucidation of problems connected with the refining of crude oils. Mechanical improvements have occurred in methods of exploitation and transport. The wider use of oil-consuming engines has given further impetus to this industry.

The refining and testing of the crude oils and their products is considered very fully, as are the uses to which these bodies are put. This section is thus of special interest to analysts.

From the scientific point of view, the section on the origin of Petroleum and natural gas has special interest. The various speculations and theories and the evidence on which they are based are given. It is almost certain that different deposits have originated differently. The Engler-Höfer dual theory had, at one time, the most adherents, but has lost favour of late among geologists.

Regulations in force in all parts of the world, relating to testing, storage, and transport, occupy nearly a hundred pages. Useful statistical appendices on import duties, etc., are included.

Finally, it must be mentioned that the numerous and comprehensive maps are exceedingly well done.

Sir F. Black's foreord constitutes a short biographical notice of the author.

This monumental work deserves the widest circulation it is possible for a technological treatise to attain. More than this can be said of no book.

J. G. F. D.

Ozone, by E. K. RIDEAL, M.B.E., M.A. (CANTAB), Ph.D. Pp. IX. + 198. London: Constable & Co., Ltd., 1920. Price 12s. net.

Since its discovery, ozone has increasingly attracted the attention of chemists and industrialists. It has been of value as an aid to research and has already found considerable industrial application.

This volume is one of a series on Electrochemistry, published under the general editorship of the late Mr. Bertram Blount. The first chapters deal with the history, properties and occurrence of ozone, and are followed by a full description of the chemical, and especially the electrical methods of its production.

Among the industrial applications of ozone which are described, mention may be made of its use for hygienic purposes. It is used for sterilising water and purifying air, and also for bleaching fibres and oils.

Organic compounds containing ethylenic linkages unite with ozone, forming ozonides, which decompose into ketones, etc., on addition of water.

The probable existence of oxozone and oxozonides (Harries researches) is also touched upon. Various methods of detection and estimation are fully discussed.

The book is well illustrated, and should commend itself to those interested in this subject. J. G. F. D.

Dictionary of Explosives, by ARTHUR MARSHALL, A.C.G.I., F.I.C., F.C.S. Pp. XIV. + 160. London: J. & A. Churchill, 1920. Price 15s. net.

The author has endeavoured to make this reference book as complete as possible.

Firstly, explosives of different countries are classified according to their use. Then follow the descriptions of the various explosives, and finally there is a list of the separate ingredients.

The introduction contains, among other matter, remarks on the various nitro-celluloses.

The dictionary will certainly be useful to specialists. J. G. F. D.

(1) *Zirconium and its Compounds*, by FRANCIS P. VENABLE. Pp. 173. Price \$2.50.

(2) *The Vitamins*, by H. C. SHERMAN and S. L. SMITH. Pp. 273. Price \$4. American Chemical Society Monograph Series. New York: The Chemical Catalog Co., Inc., 1922.

All branches of chemical science have developed to such an extent that it is difficult to keep in touch with the progress made in varied fields, and the American Chemical Society is to be congratulated on its attempt to found a chemical literature without regard to commercial considerations.

It intends to secure authors for monographs on subjects of current interest, and will critically examine their manuscripts. A high level has been attained in both volumes under review.

(1) Prof. Venable's investigations on Zirconium are well-known, and in this monograph he gives an account of the history, isolation, properties, compounds (inorganic and organic), and applications of this fairly widely distributed element. The silicate is found in Brazil, Ceylon and many other localities. Although this was known long ago, the preparation of pure zirconium has been very troublesome on account of difficulties encountered in the reduction of the oxide or haloids.

The amphoteric nature of the oxide enables a large number of compounds of this element to be obtained, and the number of technical applications of zirconium and its compounds is surprisingly great.

The list of patents and bibliography occupy 40 pages.

(2) The exact chemical nature of the vitamins has still to be elucidated. The authors of this monograph have ably summarised our present knowledge of these most important factors in nutrition.

The energy needs of the body are usually expressed in terms of calories, but the body is more than a heat engine, since the necessary carbohydrates, proteins and mineral matter may be consumed to meet all energy requirements, and yet the body will fail to maintain a healthy state. It lacks an "accessory factor."

It is now generally recognised that there are three Vitamins—"A," "B," and "C"—each functions in its own special way. The anti-neuritic Vitamin B is water-soluble, Vitamin C is anti-scorbutic, whilst Vitamin A occurs in most natural fats in which it is soluble.

Results obtained with diets deficient of one or more of these unidentified bodies are intelligently presented to the general scientific reader. The exhaustive bibliography will be found of value to biochemists and other investigators. J. G. F. D.

PLATINUM.

By GEORGE F. KUNZ.

(Continued from last week).

Germany. In relation to certain reported occurrences of platinum in the Siegerland and Sauerland districts of Germany, F. Beyschlag states, in the "Zeitschrift für praktische Geologie," that although exaggerated expectations exist as to the importance of these finds, based on inadequate and unreliable research methods, the presence of small quantities of the metal appears to be well established. The platinum occurs in an irregular and hitherto unconcentrated form, but the writer thinks there is good reason to hope that in time secondary concentrations will be met with, or that improved methods will be devised for utilising the irregularly distributed material.

In the long list of raw materials needed in Germany last September, and submitted by the German Government to the Reparations Committee, appear 150 kilos, or 4,822 troy oz., of platinum. A part of the sum due for the great amount of foods and raw materials specified in the German request is to be paid for out of the initial 20,000,000,000 marks (nearly \$5,000,000,000)- constituting the first instalment of the immense indemnity imposed upon Germany.¹ This platinum would be worth about \$350,000 and perhaps more than that.

Russia.—A thoroughly trustworthy record of the early Russian production of platinum has been preserved for us.² In the 16-year period running from 1823 to the end of 1839, the official Russian returns give the platinum output as follows:—

	Zolot-			
	Poods.	Pfunds.	niks.	Doli.
From Crown Mines	29	—	83	82
From Nizhni-Tagilsk	1,216	29	91	36
From other private mines ...	13	13	65	10
Totals	1,259	4	48	32

¹Min. Jour., Nov. 6, 1920.²Schriften der Russisch-Kaiserlichen Gesellschaft für die gesammte Mineralogie, Vol. I., Pt. I., St. Petersburg, 1842.

	Turned into grams and troy ounces thus given.	
	Grams.	Troy Ozs.
From Crown mines	175,392	15,282
From Nizhni-Tagilsk	19,930,924	640,722
From other private mines	218,547	7,026
Totals	20,624,863	663,030

At the present ruling price of platinum this would have a value of about \$40,000,000, estimating that the grade was 83 per cent.

From 1887 to 1913, Russia is said to have produced 7,837 poods' weight of platinum (4,127,318 troy oz.), and to have exported platinum weighing 6,428 poods, or 3,385,275 troy oz. This export was divided among the principal importing countries in the following proportion: France, 70.09 per cent.; Germany, 29.13 per cent.; England, 0.78 per cent. Of course, a good part of the refined platinum was in turn exported by France and Germany, mainly by France. As to the amount of platinum still remaining in the explored mines, we are told that it can be put at about 7,000 poods, or nearly 3,700,000 troy oz.

From time to time a little information as to the present Russian platinum production leaks out. Thus the London *Financial World* reported not long since that about 400 poods' weight of the metal had been mined in the Urals in 1920.¹ This would mean a production of 210,646 troy oz., which, under existing circumstances seems hardly possible. It is also stated that in the refining factory in Moscow there was secured 54 poods, or 28,436 oz. of platinum, and 3,000 poods, or nearly 1,600,000 oz. of silver.

Concerning the reported discovery of new platinum deposits in the Petshora region of the Urals, B. Simmerbach, of Wiesbaden, Germany, in an article contributed to the publication *Edelerden und-Erze*, writes that, from his personal knowledge of the district, there can be no doubt that platinum and gold are to be found in the northern part of the Urals, notably in the Pakoi region, as well as in the Petshora district, and it is his conviction that an adequate survey will reveal the existence of very valuable platinum ores here.²

¹From Dobrokhotoy's "The Urals."²Min. Jour., Nov. 6, 1920.

Osmiridium in Russia has been obtained exclusively in the Urals, from the Miass district of the Orenburg Government, and in the North Ekaterinburg district of the Perm Government,¹ although in the last-mentioned district the mining of this metal has been abandoned. The annual production had decreased rapidly within the 12 years from 1902 to 1914, with a very slight recovery after 1912. In 1902 about 231 $\frac{1}{4}$ troy oz. was produced, the production falling by rapid stages to a little over 2 $\frac{1}{2}$ oz. in 1912. In 1913 about 8 $\frac{1}{4}$ oz. was obtained, and in 1914 a trifle over 10 $\frac{1}{2}$ oz. The total for the twelve years was 906 oz.

South Africa.—A number of valuable platinum fields have been discovered in the Cala district of Cape Colony, South Africa. Regarding these deposits, which are situated in the Transkei, Dr. A. Heymann writes that the metal comes principally from the basic rocks, which are rich in magnesia, and is generally found in beds of sand or clay, which have been formed by the disintegration of the original platiniferous deposits.² In these alluvials, or placers, as they are called, the metal occurs as flakes or grains, one of the chief impurities being titanite iron. Diorite, olivines and quartzite are constituents of the deposits. As compared with the Ural deposits, those of this African region were found to lie nearer the surface, and the platiniferous strata appeared, as far as the tests went, to be even thicker than those of Russia. Regarding the deposits at Red Hill, it is stated that a decomposed rock, found at the surface, assayed 0.75 dwt. (18 grains) of platinum to the ton; at a depth of 4 ft. there was an average of 3 dwt. (72 grains = 0.15 oz.),³ while samples taken from a depth of 4 to 6 ft. gave as much as 16.25 dwt. (or about 0.8 oz.) per ton. Other samples, taken from five different localities, gave respectively 14.4, 30, 39.6, 42, 44.4, 63.6, and 297.6 grains, the latter being equivalent to 0.625 oz. per ton.

The deposits are owned by the African Platinum Mines, Ltd., and this company is asserted to have the backing of several large concerns in Capetown. The capital of

the company is reported to be £150,000. In the new platinum field there are said to be large areas where platinum occurs in small quantities, but there are also sectional zones of concentration.

In connection with the discoveries of platinum in the Cala district, it has been already noted that for several hundred miles along the margin of the Bushveld granite area in the Transvaal, pseudostratified segregations of chromite, associated with platinum, have been noted.¹ These formations are several feet thick, and are said to be quite workable, although, as yet, they have not been exploited.² In the copper-nickel deposits of Insigwa, Cape Province, platinum has been found in quantities ranging from 12 grains per ton to nearly 5 oz. per ton. However, this distribution is very irregular, but in any case should the deposit be worked for its copper content, the associated platinum would constitute a valuable by-product.

Spain.—The platinum deposits in the Sierra de Ronda, in southern Spain, occur in an enormous outcrop of peridotites, with rhombic pyroxene dominating, surrounded by a border of gneisses metamorphosed in contact with the peridotites. The gneisses, debris of the ancient covering, are also to be found in the interior of the peridotite mass, and here also the contact of the peridotite and the gneiss is direct. It may be added that the forms of erosion of the peridotites offer no analogy with those of peridotite centres in the Urals. In the alluvial deposits the disposition of the platinum in the alluvial covering differs absolutely from that observable in the Urals. In the Spanish deposits the platinum, as is frequently the case with very recent auriferous alluvials, appears to be more or less regularly disseminated through the entire depth of the formation. In the Urals, on the other hand, the platinum, at least the industrial platinum, is exclusively concentrated in the layers of compact gravel, often argillaceous, termed *peskis* in Russia.

¹Comm. Rept., Oct. 23, 1920, prepared by the Russian Division of the Bureau of Foreign and Domestic Commerce.

²So. Afr. Min. Eng. Jour., Dec. 18, 1920.

³Idem., Sept. 4, 1920.

¹Idem, Sept. 18, 1920.

²So. Afr. Min. Eng. Jour., Sept. 18, 1920.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 10201 Elektrizatsionnaya Lampa. Manufacture of albid from acetaldehyde. April 10.
 10183 Metz, H. A. Complex arsenosubstino compounds, and process of making same. April 10.
 10639 Ruppel, G. Process for treating plant culture with sulphur. April 13.
 10528 Techno Chemical Laboratories, Ltd.—Recovery of heat from treated material. April 12.

Specifications Published this Week.

- 153,290 Norsk Hydro-Elektrisk Kvaestofak-Tieselsakb. catalyst for the synthetic manufacture of ammonia and process of producing same.
 156,138 Trauns Forschungs; laboratorium Ges. H.O.—Process for the manufacture of plastic masses.
 156,146 Trauns Forschungs; Laboratorium Ges. H.O.—Process for the oxidation of acetaldehyde to acetic acid.
 156,148 Trauns Forschungs laboratorium Ges.—Process for the manufacture of formaldehyde and methyl alcohol.
 157,966 Grasse, L. C. Dry method of purifying gases and vapours.

Abstract Published this Week.

Dialkyl sulphate. Patent No. 175,077.—Messrs. The British Cellulose & Chemical Manufacturing Co., Ltd., of 8, Waterloo Place, London, have patented a process for obtaining Dialkyl sulphate by distilling alkyl hydrogen sulphates or mixtures containing them in vacuo, so that only the small portion of liquid actually undergoing distillation is heated, and so that the vapours and residue are rapidly removed from the point at which distillation occurs. For example, the liquid containing alkyl hydrogen sulphate may flow in a thin film over a heated surface, or down a heated coil or tube, or may be sprayed into the still or carried into the heated zone by a revolving drum or moving band. In an example a mixture of ethyl alcohol and fuming sulphuric acid is caused to flow, by means of a revolving office down the inside of a vertical heated tube connected to a vacuum and condensing system; diethyl sulphate separates from the distillate, the remainder, consisting of alcohol, sulphuric acid, etc., being utilised in the next operation. Dimethyl, dispropyl, dibutyl, etc. sulphates may be similarly prepared.

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CHEMICAL SOCIETY RESEARCH FUND.

A MEETING of the Research Fund Committee will be held in June next. Applications for Grants, to be made on Forms which can be obtained from the Assistant Secretary, Chemical Society, Burlington House, W.1, must be received on or before Thursday, June 1st, 1922.

All persons who received grants in June, 1921, or in June of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be returned by Thursday, June 1st.

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

PHENOL PRODUCTS.

THE PROPRIETOR of British Letters Patent No. 9291, of 1914, is prepared to sell the Patent or to license British Manufacturers to work under it. It relates to an improved method of manufacturing condensation products of phenol and substances containing the methylene radical.

Address: — B. W. & T.,

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3240.

THE SOCIETY OF CHEMICAL INDUSTRY— MANCHESTER SECTION.

FROM OUR OWN REPORTER.

"THE PROGRESS OF VEGETABLE OIL EXTRACTION,"

By R. A. BELLWOOD, M.I.M.E.

The Eighth Meeting of the Manchester Section was held on May 7th, Dr. E. Arden presiding.

Mr. R. A. Bellwood, of Hull, read a Paper entitled "The Progress of Vegetable Oil Extraction."

The Paper deals entirely with the extraction of oils by pressing machinery. Mr. Bellwood said that although it was known from the Old Testament that the Israelites had knowledge of oils, yet there is no reference to the appliances they used. It is, however, learned from the early writers that the winning of oils technically was known to the Egyptians, from whom the Israelites, in all probability, received their knowledge of the practice. It is believed that the Egyptians knew of the expressing of oils at least 5,000 years ago, and an illustration of a press for extracting juice from grapes is shown in Wilkinson's "Egypt." This press consisted of a strong wooden framework and a stout stuff bag, containing the material to be pressed, suspended horizontally between vertical posts, which were subjected to a wringing and squeezing pressure which brought out the liquid contents. In all probability the same kind of press was used for the expression of oils from olives. Vetrurius, in an article written two or three thousand years ago, mentions oil presses with very long levers. Pliny (23 A.D.) gives a description of an oil mill consisting of a set of stones for grinding olives, these stones being somewhat similar in appearance to those used at the present day. The stones were convex on the face instead of flat, as now used. A centre shaft or axle passed through the centre of the stones, which were dragged round by slaves. The olive pulp was taken from the stones and put into sacks made of woven rushes, and then placed underneath very heavy flat stones, which were lifted by means of levers, so that the olives could be placed beneath to

receive the pressure, or taken away when the pressing process was complete.

The ancients, generally speaking, used what is usually known as the "pestle and mortar" press. Like Herbert, a civil engineer, in an article published in the Engineers' and Mechanics' Encyclopædia in 1863, made the statement that he had been so forcibly impressed with the defects of the "pestle and mortar" press that he had designed a few years previously a more powerful machine, in which the combinations were few and of a simple character, and easily made by the roughest workman at a trifling expense. He asked the reader of the encyclopædia to bear in mind that the press was designed for the rural expression of oil on the spot where the seeds grew. Several writers had wrongly attributed the invention of Luke Herbert's press to the ancients.

It is difficult to decide what form of press followed the ancient lever press, but in all probability it was a crude form of the "pestle and mortar" press. The mortar was built out of the trunk of a tree, with a lining usually made of boxwood. There was a long paw which was used as a pestle, and this was given a rolling motion by means of a rope arrangement and bullock power.

A modified form of the "pestle and mortar" apparatus is commonly in use in India and China, and Mr. Bellwood produced an actual cake made in one of them. A typical installation, shown upon the screen, was made pre-war for £20. This was an indication of the difficulty facing English engineers when competing with native labour.

In all probability the "wedge" press followed, or was contemporary, though its use, apparently, has now been discontinued. When using the "wedge" press, the seed was first ground under stones, and a form of stone which is used even to-day in some parts of China was exhibited upon the screen. There was only one stone, with a small diameter and very large face. The seed was passed into a feeding box by means of a small slide. The power was supplied by bullock or horses. The ground seed was taken away from the stone in a riddle closely resembling those used by housewives to-day for riddling cinders, and placed on the top of a copper similar to that used to-day for clothes washing purposes. Steam was evolved from the cop-

per, moistening and tempering the seeds, being practically the same process adopted in modern oil mills. After tempering, several measures of the meal were placed in a bag made of straw, the whole again being put in a container arranged below two heavy beams. Pressure was applied to the material by means of a long wedge arranged between the two beams, so as to force them apart. The wedge was driven in by means of a heavy hammer suspended from the ceiling. Near the bottom of the container there was a pipe arranged to carry away the oil.

Stamping mills were used in the 10th century for crushing oil seeds, and Zeisung describes an oil mill of this type. The "sledgehammer" press was improved by the Dutch in the 17th century. They introduced a "stamper" press which was not used for crushing the seed, but which was actually a press. In the early Dutch mills the seed was crushed under upright, revolving stones. It was heated in pans over an open fire, and the oil was then expressed by means of the stamper wedge press. The Germans, as is their wont, claimed the credit of first producing the vertical type of stamper-wedge press, but there is no doubt that it was the Dutch who introduced it into England. These stamper mills were almost entirely built of wood, and the workmanship reflected great credit on the old millwrights.

An illustration was shown of an early Dutch mill which was running about the year 1790. The power was supplied by a wooden waterwheel of about 18 ft. diameter and 4 ft. wide. A pair of cast-iron rollers crushed the seed before it went to the stone. The frame, driving shaft, wheels and stamper were made of wood. Stamper mills driven by water power were installed at Liverpool in 1804.

In 1858, Alexander Samuelson, of Hull, a manufacturer of oil machinery, gave a lecture before the Society of Mechanical Engineers, which is reported in Spon's dictionary, and described an old type of stamper press which was in use in this country until 1860.

It is believed that stamper mills were in existence in Hull at the end of the 17th century, and it is known that there were at least two of these mills at work in 1810. They were superseded by the hydraulic press, which was made possible by Bramah's invention of the "U" Ram

Leather. This invention revolutionised the oil-milling industry. It is difficult to say with certainty when the first hydraulic press was made for use in oil-mills, but it is generally believed that in England it was about 1814, in Germany about 1818, and in France about 1819. They were in use in Hull about 1830. A press was made by Mr. Bramah, and sent out by the British Government to Ceylon, for the purpose of expressing oil from coconuts. The hydraulic press did not gain the confidence of the public as quickly as it should have done. A number of other developments occurred including the introduction of the steam-heated kettle. It is not definitely known when the idea of steam jacketing the kettle bottom was first mooted, but it was after the year 1787, because Smeeton then took out a patent for cooking kettles, which he described as being heated by water or sand.

A Mr. Blundell, of the firm of Blundell, Spence & Co., colour manufacturers, is credited with being responsible for the design of the "Four-box" hydraulic press, and he introduced it into his mill at Hull about 1830. Among the earlier manufacturers of this press were Whitman, of Leeds; Rose, Downs, Thompson & Co., of Hull; and Alexander Sanderson & Co., of Hull. It was first introduced in Liverpool about 1845. The style of hydraulic pumps used in those times is still in vogue. The diameter of the press ram was 12 inches, the stroke was about 10 inches, and the press was fitted with four boxes, and received four bags of seed, producing a weight of 64 lb. of meal, or cake, at each operation. Samuelson describes the seed as being carried to the press in canvas or hair bags. In 1847, James Robson proposed the substitution for hair cloths of an instrument which was constructed of two metal perforated plates.

Smeeton improved the operation of roller mills by making the rolls of unequal diameters. Practically no variation had been made in the type of "edge runner" stones. W. E. Newton, in 1856, patented a device for the continuous feed of material to the stones, with an arrangement of sweepers whereby it was taken away gradually as it was ground, thus rendering the process quite automatic. This same principle was in use to-day in many of the larger oil mills in this country.

It has been generally understood that the idea of using a press with a number of supported plates, and a moulding machine to give the prepared meal a preliminary compression, dated from the year 1874. To use a common expression, "there is nothing new under the sun," and this was found to be so by Mr. James Downs, of Hull, who, in 1874, patented a press for extracting oil from seeds, and which entirely superseded the "four-box" presses. It consisted of a series of wrought-iron plates, upon either side of which is riveted, or otherwise fixed, preferably, corrugated plates. Each press was made to take 16 cakes instead of four as with the existing box presses.

The "Cheeseborough" patent, taken out two years before that of Downs', also had 16 plates. It is rather peculiar that these two people, who knew nothing whatever about each other, should have arrived at a similar result.

For 16 years a great invention had lain dormant. In 1856 a patent was taken out in the name of W. E. Newton, upon a communication from abroad. The patent does not state where the communication came from. Newton describes, and claims for, a cake-moulding machine and a cake press for making 16 cakes at one pressing. Thus, the 16 cake pressing machine existed in substance and in fact. It is almost inconceivable that for 16 years an invention of that kind should have lain dormant, and that all that time this and other countries should have been struggling with the old "four-box" press.

The first mill built on the "Anglo-American" system was put up by Messrs. Rose, Downs & Thompson, of Hull, for Messrs. Willows and Holt, in 1874, and had eight presses. There was also a mill built in the same year for Pearson Brothers, of Gainsborough. It is doubtful which of the two mills ran first. In 1878, Edward Ross Walker took out two patents which may be classed as notable improvements. In one patent he employed a hydraulic accumulator, which was to be worked from a larger or low-pressure pump, and a larger number of presses could be operated with the one pump. The hydraulic moulding machine invented by Ross Walker had a spring head which permitted the seed to fall from its box.

The invention of the "Anglo-American" press naturally brought a great many improvements in its train, as the auxiliary

machines hitherto used in connection with the box presses could not deal with the larger output. The grinding machine which is known as the "Anglo" roll was introduced. This consisted of several cast iron rolls placed above each other, having an average of about 16 inches diameter. With an up-to-date set of rolls the operator can see exactly what feed is passing between them. Larger cooking kettles were also employed, and arrangements made for transmitting the seed more quickly from the kettles to the moulding machine, while greater attention was paid to the heating and tempering of the seeds.

An illustration of an automatic machine used in the larger mills was then shown. It served 12 presses, and was made by Greenwood and Batley, of Leeds. The 12 presses could be quite easily worked by one man. The automatic "Anglo-American Cake Paring Machine" was practically independent of the workman in regard to its operation.

A cinematograph film showing the method of operating modern oil mills and their machinery was then shown.

Mr. Terleski moved, and Dr. Callan seconded, a vote of thanks to Mr. Bellwood for his lecture.

THE CHEMICAL SOCIETY.

INFORMAL MEETING.

An Informal Meeting was held on Thursday, May 18th, 1922, following the business of the Ordinary Scientific Meeting at 8 p.m. A selection of autograph letters from the Roscoe Collection and of books of historical interest from the Library was exhibited.

DETERMINING SULPHUR DIOXIDE.

By G. BASIL BARHAM, M.Inst.M.

One method of determining the presence of sulphur dioxide which has not as yet been used either in the laboratory or in commercial operation, is to expose a piece of the so-called "rustless" iron to the action of the suspected body, sulphur dioxide being the one compound which will attack a silicon-iron alloy eagerly. A better method is that of titration with potassium permanganate, 0.005 N potassium perman-

ganate being the best strength to use. Messrs. Sweeney, Outcault and Withrow state that one drop of this corresponds to 0.000009 grammes of sulphur dioxide, the low normality making it possible to ensure great accuracy, but they point out that a much stronger solution should be used for a large concentration of SO_2 . In a method used by them, the solution was prepared by diluting the laboratory stock solution, which was standardised with purified sodium sulphite after being allowed to stand for several days. (*Journ. Ind. and Engng. Chem.*, Oct., 1917.)

It has been shown in actual operation that the advantages of potassium permanganate over iodine for determining sulphur dioxide are that whilst it is as easy to prepare, it can be more easily manipulated and gives as great accuracy; it can be used on either large or small amounts; it requires no simultaneous blank, and so cuts down the amount of apparatus to be transported; is more stable to light, and gives a colour as easy or easier to match than the starch-iodine end-point. The permanganate must always be present in excess, for which reason it is impossible to titrate the sulphurous acid directly. There was, however, a scheme described in the findings of the Selby Smelter Commission, which gets over much of the difficulty, and with this is a certain amount of the potassium permanganate is run into dilute sulphuric acid, and as soon as the mixture is effected it is divided into two equal portions. The sulphur dioxide is then dissolved in one of the parts, and by means of a burette standard permanganate is added until the colour of the two portions exactly matches. The amount added is sufficient to oxidise the sulphur dioxide and still be in excess. According to a record of experiments made by the authorities quoted, the best colour to match is produced by adding 10 cubic centimetres of approximately 0.005 N permanganate to 490 cubic centimetres of water. After the permanganate is reduced, the color on back-titration may not, and generally does not, match to original, but has a slightly reddish tinge. They say, however, that if the solution is reduced and oxidised once or twice before it is divided, little difficulty will be found in matching the colour exactly.

From 25 to 50 cubic centimetres of sulphuric acid (2N) should be in the solution, as less than this amount will give a red

solution which cannot be matched easily whilst a surplus will act on the permanganate. Prolonged tests show that when any considerable amount of sulphur trioxide accompany the SO_2 , the best plan is to use 25 cubic centimetres of the double normal acid. It has been found that the reaction is complete in the cold, and the titration is made at ordinary temperature. Merely shaking the permanganate solution in the sample bottle, free from sulphur dioxide, causes no loss of colour, consequently there is no need to run a blank, but only to match colour accurately.

Regarding the apparatus used, this consisted of a bottle or carboy holding at least 24 litres, fitted with a properly cleaned, two-holed rubber stopper with large stopcock and a plug, to be used as a sample bottle; together with two 500 cubic centimetre bottles of uniform clear glass for titrating, these being quite clear and free from "waves" to facilitate the colour matching. One of these should be provided with a two-holed rubber stopper containing a glass tube which will reach to the bottom. Other requirements are a white background; a 25 cubic centimetre burette; a 1,000 cubic centimetre bottle for diluting and mixing the solution of permanganate; a suction pump for emptying the sample bottle, and a manometer tube or gauge for obtaining the amount of evacuation. It is added that for very accurate work two Nessler tubes should be provided.

In practical work the sample bottle is evacuated, the internal pressure carefully noted, and a note taken of the temperature. The end of the tube in which is the stopcock is then placed in communication with the source of the gases to be analysed or with the flue through which they are passing, and the stopcock turned on and left in that position for a few moments until the sample bottle or carboy is completely filled; should this stopcock be closed too quickly there is a real danger that the gas may be attenuated, and although it is a simple matter to calculate the volume present, there is no reason why care should not be taken to see that the sample bottle is properly filled. For the purpose of determining the amount present the stopcock is closed and the temperature and barometric pressure ascertained, from which data the calculation is simple.

After measuring out about 475 cubic centimetres of water and putting them in the

1,000 cubic centimetre bottle, 30 cubic centimetres of 2N sulphuric acid are added, and after an interval, 10 cubic centimetres of standardised 0.005 N potassium permanganate are poured in. After mixing, the solution is divided equally in the two 500 cc. bottles. To one of these bottles sodium sulphite solution, or sulphurous acid, is added until the colour is faint, after which it is roughly restored by adding fresh permanganate. The solutions are now mixed and again divided; the burette is filled with standard permanganate solution, and the position of the meniscus noted. Mr. Sweeney then added such an amount of the solution to one of the bottles as would prevent the sulphurous acid from decolourising the solution, supposing the gas to be present in such proportions as would render this likely to happen.

The two-holed rubber stopper and tube are then placed in the permanganate bottle, the gas sample bottle is inverted, and the free end of its stopcock placed through the free hole of the permanganate stopper. When the stopcock is opened, the solution runs into the sample bottle as soon as the plug is removed, and in this connection several methods, such as bending the stopcock tube and placing the sample bottle on its side, can be adopted for convenience and to save undue handling. The sample bottle is then agitated for a time—a fairly simple method of dealing with this sample bottle would, in the writer's view, be to either place it on a couple of rockers capable of being scotched when required, or to fix it in gimbals—and the solution is then run back into the small bottle from which it was taken and titrated with permanganate until the colours of the two portions approximately match. It should then be run again into the sample bottle and agitated, and then run out into the small bottle again and very carefully matched for colour. This will have to be done against the white background mentioned and, as Mr. Sweeney points out, for very close work the Nessler tubes can be used. The total amount of permanganate run from the burette gives the amount of sulphur dioxide in the sample, and it will be seen that the details of manipulation are, broadly speaking, the same as those which were worked out so thoroughly for the iodine method by the Selby Smelter Commission. —(Bull. 98. U.S. Bureau of Mines.)

GENERAL NOTES

Watts's Index of Spectra Y. has now been published, containing data for *Iodine* and *Iridium*, and can be obtained from Mrs. Marshall Watts Ingleboro, Victoria Avenue, Southend-on-Sea, 7s. post free.

We understand that the Automatic and Electric Furnaces, Ltd., have introduced a marine-type of Wild-Barfield Electric furnace for use on board ship.

We learn from a pamphlet that has been forwarded to us from the University of Kansas that the study of Dietaries upon sound scientific lines has been started in some of the State institutions, with the object of determining *whether the food supplied is suitable, whether cheaper or other forms of food could be substituted with advantage*, and many other points of importance. The foods used with their protein, fats, carbo-hydrate, and calorific values are tabulated. We note with some interest that the list of foods used in the Penitentiary at Lansing contains ducks, oysters, peaches, radishes, cucumbers! They appear to live fairly well in the prisons of Kansas.

TEMPERATURE CARBONISATION.

The various views put forward at the conference recently held by the South Wales Institute of Engineers regarding low temperature carbonisation are summarised, and appear in the *Manchester Guardian Commercial*:—It is not easy to give an exact definition of the term, "low-temperature carbonisation" of coal. High-temperature carbonisation consists in heating raw coal in closed retorts or ovens at about 1,600-2,000 deg. F. In the gasworks process the main object is the production of as much gas as possible, and in the coke oven to obtain a hard metallurgical coal. Both these processes result in the decomposition of a large portion of the volatile matter of the coal into gas. The object of low-temperature carbonisation may be said to be to obtain the maximum yield of valuable liquid products from the volatile matter, to reduce the gas yield to a minimum, and to obtain a residual fuel which, while being smokeless like coke, will be easily ignited and suitable for a household fuel. Dr. Lander, of the Fuel Research Board,

gave as his opinion that the answer to the question, "Will it be possible to establish on sound industrial lines a new industry based on the carbonisation of tens of millions of tons of coal per annum?" was that "the knowledge and experience which had been gained as the result of much patient work during the past few years have brought the answer almost within reach." If the problems of low-temperature carbonisations are solved it means a revolution in industry. Great Britain raises 250,000,000 tons of coal per annum and consumes at home 187,500,000 tons, of which 20,000,000 tons are used for coke ovens, and 18,000,000 tons for gasworks. If the remaining 149,500,000 tons were submitted to low-temperature carbonisation we should have available about 500,000,000 gallons of motor spirit (more than twice our consumption of petrol), 75,000,000 barrels of oil, and 1,350,000 tons of sulphate of ammonia. The total national saving would be over £250,000 per annum, including the complete abolition of black smoke and practical independence of the rest of the world for liquid fuel and fixed nitrogen."

GERMAN DYES.

In the House of Commons last week, Mr. Waddington asked the President of the Board of Trade whether any increases had recently been made in the price of German dyes for qualities not produced in this country; whether for German dyes of qualities which could be efficiently produced in this country the prices were being reduced; and whether he had any information that certain leading textile dye users in this country recently visited Germany and recommended German dye-makers to artificially reduce the price in this country of German dyes which competed with similar British dyes?

Mr. Baldwin replied: I understand that the German Dye-Stuff manufacturers have recently raised their prices generally, but that when dyestuffs equivalent to their products are put on the market by British manufacturers, it is their practice to reduce their prices in an attempt to undercut the British producers. As regards the last part of the question I have no doubt that some British consumers have sought to obtain specially low quotations from Germany.

Mr. Gratton Doyle asked the President of the Board of Trade whether he could

give a return of the quantities of dyestuffs admitted by the licensing committee appointed under the Dyestuffs Act of the quantities which had been refused admission, and of the particular exporting countries in each case?

Mr. Baldwin replied: Particulars of applications for licences which were granted or refused during the year 1921, and the months of January and February, 1922:—

	Granted.	Refused.
	lbs.	lbs.
From Switzerland ...	2,138,171	610,755
Germany	796,215	991,894
Other sources	216,455	268,568
Total	3,150,841	1,871,217

Captain Wedgwood Benn asked whether, seeing that the London memorandum of the experts states that the limitation of import should be effected by the medium of Customs duties rather than by a system of prohibition modified by licences, an amendment to the Dyestuffs Act was to be introduced by the Government?

Mr. Bridgeman replied: The answer is in the negative. Dyestuffs constitute one of those special cases which the memorandum expressly contemplates.

Mr. Hilton Young informed Mr. Ormsby-Gore that the total amount received to date by way of dividends on the Government's investments in the British Dyestuffs Corporation was £133,025 4s. 5d. A payment of £54,600 on account in respect of interest and sinking fund for the year ended the 30th June last had been made by the British Phosphate Commissions to the Exchequer. No return had been obtained from the investments in the British Cellulose Company.

Sir William Barton asked the President of the Board of Trade whether his attention had been called to an application made by W. T. Alexander, of 6, Brown Street, Manchester, for a licence to import a small quantity of algole 5G powder; whether he was aware that the applicant was informed by the licensing committee that a similar product could be obtained from the British Dyestuffs Corporation, Limited, from whom he obtained a sample; whether the Board was aware that this sample was tested by the actual consumers, who reported direct to the licensing committee that the proposed substitute was not so pure and rich in tone as algole 5G, and that its properties as regards fastness were not so good; whether he was aware that the price

reckoned on the basis of price per lb. and tinctoral value was more than three times that of the colour asked for, and that the consumers in question had no desire to get colour abroad if they could be reasonably supplied at home; and whether, the facts being as stated, he would give instructions to grant a licence?

Mr. Baldwin replied: I have made enquiry into this case. The Advisory Licensing Committee have investigated the quality of the British product and are satisfied that in this respect there is no sufficient reason for the grant of a licence. As regards price, the consumers concerned have been asked to furnish the Committee with certain information, on receipt of which the matter will be further considered.

Replying to Major Barnes, who asked whether his attention had been drawn to a statement to the effect that the leading French dyestuffs company, La Compagnie Nationale de Matieres Colorantes et de Produits Chimiques, had come to an arrangement with the German dye trust, the Interessen Gemeinschaft, whereby, in return for the disclosure of German dye secrets and technical assistance, the French company undertook to confine their sales to French dominions and to pay to Germany half of their profits; and if he could say whether a similar arrangement was contemplated between the German company and British Dyes, Limited, Mr. Baldwin, President of the Board of Trade, said:—As regards the first part of the question I would refer my hon. and gallant friend to previous answers. As regards the second part, I have no reason to suppose that an arrangement between the British Dyestuffs Corporation and the Interessen Gemeinschaft of the kind indicated is contemplated by the former.

BRITISH CELLULOSE COMPANY.

Mr. Neil Maclean asked the Secretary to the Treasury whether the British Government held £1,450,000 preference shares in the British Cellulose and Chemical Manufacturing Company; whether this company had lost over £1,000,000 during the last two years; whether a scheme for the reconstruction of the company had been submitted providing for a holding company with £500,000 capital running the business; whether the British Government had agreed to assist this scheme by giving the

new company £750,000 preference shares; whether the market price of those shares when this arrangement was made was £166,250; and whether, seeing that this action had been agreed upon without consulting the House of Commons, its consent would be asked for before those shares belonging to the British Government were given away for nothing to a private company?

Mr. Hilton Young replied: The answers to the first four parts of the question are in the affirmative. For the full statement of the position I would refer the hon. member to the statement made by the Chairman of the Company at their general meeting on Monday last. As regards the fifth part, the shares, except in very small numbers, were practically of no realisable value at the time of the agreement to surrender a part of them to the parties furnishing the additional capital required to prevent the company going into liquidation. The answer to the last part of the question is in the negative.

GAS POISONING.

In answer to Sir Robert Clough, who asked whether his attention had been called to the frequent cases of poisoning by carbon monoxide gas; whether he had seen the statement that this is apparently due to the new type of gas manufactured; and whether, in any event, he would investigate the frequency of these cases so as to reassure the public and avoid, if possible, any further recurrence, Mr. Baldwin replied: I may remind my hon. friend that the Board of Trade appointed a special Committee to investigate this subject, and had already given effect to the recommendations of the Committee. All cases of fatal accidents attributed to gas poisoning are reported to the Dept., and reports thereon are made to them by the Medical Officers of Health. I should add that there has not been any marked change recently in the proportion of water gas supplied by gas undertakings.

SEWERAGE PURIFICATION.

Lieutenant-Colonel Assheton Pownall asked the Minister of Health whether his attention had been drawn to the discovery by Mr. Thomas H. Fairbrother, M.Sc., and Dr. Arnold Renshaw, of Manchester, of several dyes which in the activated sludge

process of sewerage purification could kill the devouring protozoa without harming the purifying bacteria; and whether he would give facilities for carrying out on a large scale the results of this highly important piece of laboratory research work.

Sir A. Mond replied that his attention had been drawn to the experiments referred to. He was, however, advised that further research work would be needed in order to test the application of this and other discoveries to the activated sludge process of sewage purification, and he was making inquiries as to the best means of facilitating the necessary investigations.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

THURSDAY, MAY 11, 1922, AT 4 P.M.:

ELECTION OF FELLOWS.

At 4.30 p.m. Papers read:—

Lord Rayleigh, F.R.S. (1) A Photographic Spectrum of the Aurora of May 13-15, 1921, and Laboratory Studies in connection with it; (2) A Study of the Presence or Absence of Nitrogen Bands in the Auroral Spectrum.

C. Chree, Sc.D., F.R.S. The 27-day Period (Interval) in Terrestrial Magnetism.

M. Barker. On the Use of Very Small Pitot-tubes for measuring Wind Velocity. Communicated by Cr. G. I. Taylor, F.R.S.

E. T. Paris. On Doubly Resonated Hot-wire Microphones. Communicated by Prof. H. L. Callendar, F.R.S.

Prof. J. C. McLennan, F.R.S., and D. S. Ainslie. On the Structure of the Line $\lambda = 6708$ A.U. of the Isotopes of Lithium.

ORDINARY MEETING—MAY 4, 1922.

Sir Charles Sherrington, President, in the Chair.

The following papers were read, the Summaries here printed having been supplied by the Authors for use at the Meeting:—

C. Shearer, F.R.S. On the Heat Production and Oxidation Processes of the Echinoderm Egg during Fertilisation and early Development.

In this paper an attempt is made to measure the heat liberation of the egg of *Echinus miliaris* during fertilisation and early development, and to correlate this with the amount of oxygen consumed and the carbon dioxide given off at the same

time. New methods hitherto unused for this purpose have been employed. The heat production has been measured by means of the differential micro-calorimeter, while the oxygen consumption and carbon dioxide output have been estimated with the differential manometer.

In one hour, 1 million unfertilised eggs (8 mgrm. egg N.) consumed 15.1 c.mm. of oxygen at standard barometric pressure (760 mm. Hg.) and Temp. 14.5° C., and gave off at the same time 0.067 gm. calorie of heat. In a similar interval the same quantity of fertilised eggs under the same conditions consumed 86.4 c.mm. oxygen (with a corresponding output of CO₂; respiratory quotient, 0.92), and liberated 0.397 gm. calorie of heat. Thus the fertilised egg gave off 6 to 7 times more heat, and consumed 6 to 7 times more oxygen than the unfertilised egg.

The heat production of the egg-cell in one hour, expressed in gm. calories, divided by the oxygen consumption of the egg in the same time, expressed in milligrams oxygen, gives a calorific quotient Q. This was found to be approximately the same value in the unfertilised as in the fertilised developing egg-cell, being 3.07 in one instance, as compared with 3.22 in the other. This would seem to show that extremely little of the very large amount of chemical energy liberated in the egg as the result of fertilisation, is expended in bringing about the visible morphological structure of the developing ovum. The heat liberation of the ovum after fertilisation rises progressively during development, reaching the highest point when the free-swimming stage is reached. The oxygen consumption and CO₂ output of the egg follows the heat liberation in all respects.

Johan Hjort, For. Mem. R.S. Observations on the Distribution of Fat-Soluble Vitamines in Marine Animals and Plants.

The author, when studying the periodical changes in the size and quality of fish at different seasons of the year, found that these were associated with changes occurring in the content of fat. In Cod, for instance, the changes in the quality of the fish are most easily demonstrated by inspection of the size of the liver, an organ of which 50 per cent. consists of "cod-liver-oil." It was found that the liver of full-grown cod during the summer season, when the fish was feeding, weighed no less than three times as much as in winter, during the spawning season. The seasonal varia-

tions in the quality of the fish do not coincide with temperature variations, nor, in the case of the cod, with the availability of the animals which serve it as food.

The suggestion, therefore, arose that they might depend upon variation in chemical qualities of available food. It was therefore decided, as a preliminary to a full investigation, to study the distribution of fat-soluble vitamins in sea organisms, since these are known to exert a great influence on growth. The following materials were studied: (1) Green Algae (*Ulva*); (2) Diatom-plankton; (3) Shrimps and prawns; (4) Hard roes of herring and cod.

It was found that the above materials, fed fresh or dried, had a very marked effect in re-starting and maintaining the growth of rats, when this had failed as a result of feeding upon a diet free from fat-soluble vitamins. Fats extracted from algae and from roes had similar effect.

The results strongly suggest that fat of diatoms also contains vitamins.

H. Hartridge and R. A. Peters. Interfacial Tension and Hydrogen Ion Concentration. Communicated by W. B. Hardy, Sec. R.S.

Measurements of the interfacial tensions between oils, glycerides or fatty acids and various aqueous fluids were obtained by the capillary height, drop-weight, and ripple methods. The agreement between the results obtained by the three methods showed that any one of them could be used for studying the interfacial tensions in the case of these substances. The drop-weight method, owing to its convenience, was therefore employed alone for this research.

It was found that a decrease in interfacial tension between a fatty acid or glyceride and aqueous fluids occurs with increasing alkalinity of the aqueous fluid. This decrease is found to be dependent upon (a) the concentration of the fatty substance in the oil phase; (b) the presence of a certain concentration of alkali in the aqueous phase; (c) the hydrogen ion concentration at the interface.

Out of a series of pure chemical substances, it was found that only the substances having a COOH group (free or combined, as tri-glyceride) gave the interfacial tension changes described.

W. Cramer, A. H. Drew, and J. C. Mottram. Blood-Platelets: Their Behaviour in "Vitamin A" Deficiency, and after "Radiation," and their Relation to Bac-

terial Infections. Communicated by Prof. W. Bulloch, F.R.S.

The absence of the fat-soluble vitamin from the diet always leads in the rat to a progressive diminution in the number of blood-platelets. This thrombopenia is the only constant lesion which we have found, so far, in every case of vitamin A deficiency; and we regard it as the lesion characteristic of this deficiency, just as lymphopenia is characteristic of the vitamin B deficiency. Thrombopenia may even be found in rats kept on a vitamin A-free diet, when they do not yet show any obvious signs of ill-health and are to all external appearances normal animals. When profound thrombopenia has been established, addition of the missing vitamin A to the diet is followed by rapid increase in the number of platelets up to the normal, provided that the animal has not been allowed to suffer too long and too severely from deficiency.

Exposure to radium produces not only lymphopenia, but also, with sufficiently large doses, thrombopenia. From this the animals recover rapidly, if the application of radium is discontinued and the dose has not been too large.

If, by exposure to radium, or by withholding the fat-soluble vitamin, the number of platelets has been reduced below a certain critical level—about 300,000 for the rat—the resistance of the animal to infection is greatly diminished and infective conditions develop spontaneously. These may lead to a secondary anaemia. The infective conditions may clear up again as the number of platelets is made to increase.

Blood platelets fulfil an important function in the mechanism of resistance to bacterial infection. Alterations in local or general resistance to infection are associated with local or general changes in distribution of the platelets.

THE OPTICAL SOCIETY.

A lecture on "The Mechanical Construction of the Microscope from a Historical Standpoint," given by Prof. Alan Pollard before the Optical Society on April 27th, at the Imperial College of Science, dealt with the evolution of the instrument from the earliest times up to about the middle of the XIXth century.

Prof. Pollard divided his subject into two main periods, that of the non-achromatic, in which the early history of the single

lens or simple microscope was dealt with, and the achromatic. The mechanical details of outstanding historical compound instruments in these two periods which marked the progress of mechanical construction up to that of the modern compound microscope, were described.

Many famous instruments of the first period, such as John Marshall's "New Invented Double Microscope" of 1693, Culpeper's "Double Reflecting Microscope" of 1735, Cuff's "Double Constructed Microscope" of 1744, B. Martin's simple and compound of 1765, Bleuler's "Universal" of 1788, Jones' "Most Improved" of 1798 by Dollond, Gould's Pocket Microscope by James Smith in 1826 which marked the opening of the second period in this country, were set up with historical specimens so that their mechanical and optical performance could be compared.

In addition to the above, early catoptric instruments were shown, including Amici's reflecting microscope made for Dr. Wollaston in 1830.

The development in particular of the modern English limb from the Lister and Jackson designs and the so-called Continental limb from the early forms of Oberheuser and Nachet was traced and described.

The lecture was illustrated by lantern slides, and the historical instruments exhibited were loaned from the magnificent Court Collection as well as others in the South Kensington Museum by the courtesy of the Director, Col. H. G. Lyons, F.R.S.

ROYAL MICROSCOPICAL SOCIETY.

A Meeting of the Society will be held in the Lecture Hall at 20, Hanover Square, London, W.1, on Wednesday, 17th May, 1922, at 7.30 for 8 p.m., when the Annual Exhibition of Microscopic Pond Life will be held in the Lecture Hall and Library from 7.30 to 10 p.m. Offers of assistance from Fellows who can exhibit living specimens will be gladly received by the Hon. Secretaries.

The names of the following gentlemen will be submitted to the ballot for election as Ordinary Fellows of the Society:—

M. Arthur Benjamin Bradley, F.C.S.
Mr. James Joseph Jackson.
Mr. Arthur Mackay.
Mr. J. R. Norman.

The Metallurgical Section will meet in the Society's Library on Thursday, 25th May, 1922, at 7 for 7.30 p.m., when Mr. L. Singlehurst Ward, B.Sc., will make a communication, "Notes on Etching and Etching Re-Agents." Fellows of the Society are asked to extend an invitation to this meeting to any friends who may be interested.

Hon. Secretary: Mr. F. Ian G. Rawlins, White Waltham Grove, Maidenhead, Berkshire.

The Biological Section meets in the Library on the first Wednesday in each month, at 7 for 7.30 p.m. Hon. Secretary: Mr. J. Wilson, 3, West Park Road, Kew Gardens, S.W.

The Leather Industries Section.—Hon. Secretary: Dr. S. H. Browning, 22, Harley Street, W.1.

The Paper Industries Section is in course of formation, and will deal with researches relating to timber, wood pulp, paper, etc. Those who are interested in the subject and willing to assist are asked to communicate with Mr. James Strachan, F.Inst.P., 74, Blenheim Place, Queen's Cross, Aberdeen.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

ANNUAL GENERAL MEETING, THURSDAY, 25 MAY, 1922, at 6 P.M.

Notice is hereby given that the Annual General Meeting of the Institution of Electrical Engineers (Corporate Members and Associates only) will be held on Thursday, 25th May, 1922, at 6 p.m., at the Institution Building, Savoy Place, Victoria Embankment, W.C.2, to receive and consider the Accounts for the year ended 31st Dec., 1921, and the Annual Report of the Council, and to elect Auditors.

Copies of the Accounts and Report (which will in due course be published in the Journal) can be obtained from the undersigned.

By Order of the Council,
P. F. ROWELL, Secretary.

10th May, 1922.

ANNUAL CONVERSAZIONE, THURSDAY, 29

JUNE, 1922, 8.30 TO 11 P.M.

The Annual Conversazione will be held on Thursday, 29th June, 1922, 8.30 to 11 p.m., at the Natural History Museum, South Kensington, S.W.

Invitation cards will be issued in due course.

ROYAL INSTITUTION.

A General Meeting of the members of the Royal Institution was held on the 8th May, Sir James Reid, Bart., Vice-President, in the chair. The deaths of Sir Alfred Kempe and Sir William Phipson Beale, late Vice-Presidents and Managers, were announced, and resolutions of condolence with the families were passed. Mr. J. P. Blessig, Dr. W. D. Halliburton, Dr. E. H. Hankin, Mrs. Percy Macquoid, Mr. S. T. Nunn, and Mrs. Theodore Stephenson were elected members.

MANCHESTER LITERARY AND
PHILOSOPHICAL SOCIETY
(CHEMICAL SECTION).

At the Annual General Meeting of the Chemical Section, held on Friday, 5th May, 1922, the following were elected officers and members of Committee for the Session 1922-23:—Chairman, Leonard E. Vlies, F.C.S., F.I.C.; Vice-Chairman, H. F. Coward, D.Sc., F.I.C.; Hon. Secretary, David M. Paul, B.Sc., A.I.C.; Committee, W. H. Bentley, D.Sc., R. H. Clayton, B.Sc., Harold Moore, M.Sc.Tech., F.C.S., A.I.C., Rona Robinson, M.Sc., A.I.C., David Bain, D.Sc., David Cardwell, M.Sc., F.I.C., J. A. Russell Henderson, D.Sc., F.C.S., F.C., Thompson, B.Sc., D.Met., and J. C. Withers, Ph.D., A.I.C.

CHEMICAL NOTICES FROM FOREIGN SOURCES

ACTION OF ACIDS UPON AMMONIUM MOLYBDOMALATE—*E. Darmonis*. There are two distinct compounds of M_6O_3 with matic acid, viz., $2 M_6O_3 \cdot C_4H_5$ (dextro rotatory) and $M_6O_3 \cdot 3C_4H_5$ (levo rotatory). They

give well defined salts of ammonium, and the salt of the former is very active. It is very sensitive to the action of bases, which convert it finally into a mixture of neutral molybdate and neutral malate. It is also very sensitive to the action of acids, hydrochloric acid for example, causing a very rapid decrease of the rotatory power. Whatever the concentration, the rotation approaches a definite limit which is the same for HCl , H_2SO_4 and HNO_3 , and which undoubtedly corresponds to the formation of a compound which resists the further action of the acid. The formula of the compound appears to be $M_6O_3 \cdot 2C_4H_5 O_5$. Its rotatory power and its rotatory dispersion (much higher than that of malic acid or neutral ammonium malate) are characteristic. Acetic acid acts similarly to the mineral acids, but its action is not nearly so marked.—(*Comptes Rendus*, CLXXIV., No. 16, 1922.)

A NEW RADIOACTIVE MINERAL, SODDITE—*Alfred Schoep*.—Curite obtained from Kasolo (Katanga, Belgian Congo) is often associated with a mineral of yellowish colour. The minerals form crystalline aggregates of fine grain and tinged with orange colour. These aggregates are filled with veins, in which are brownish or reddish crystals of curite and yellow translucent or opaque crystals consisting of a new mineral. Its hardness lies between 3 and 4. Its crystals are rhombic, and they appear yellowish under the microscope. When they are heated in a closed tube they lose water and give off oxygen, at the same time turn ink black. They do not regain their original colour on cooling. The powdered mineral is pale yellow. It is infusible before the blowpipe. It is soluble in acids, giving a gelatinous precipitate. The solution is coloured yellow by manium. The average composition of the mineral after it has been dried at 100° to constant weight is

SiO_2	7.85
NO_3	85.53
Fe_2O_3	.40

The composition can be expressed by the formula $12 U O_3 \cdot 5SiO_2 \cdot 14H_2O$. The author suggests the name soddite for this new mineral, the radioactivity of which corresponds to the amount of uranium it contains.—(*Comptes Rendus*, CLXXIV., No. 16, 1922.)

ACID METHYLARSINATE OF STRYCHNINE—*J. Bouillot*.—Commercial methylarsinate of strychnine does not consist of the neutral salt, for its percentage of arsenic is much too high, and that of strychnine too low. When the pure methylarsinate is prepared from methylarsinic acid and strychnine, it forms long colourless needles which are less bitter than the sulphate. It is levorotatory. It can be kept at the ordinary temperature, but decomposes when heated above 60°. On platinum foil it burns with an odour of cacodyl. The analysis of the compound shows that strychnine combines molecule for molecule with methylarsinic acid giving a well defined acid salt which crystallises with two molecules of water, and the commercial methylarsinate used in therapeutics corresponds to this acid salt. The acid salt contains only 65.49 per cent. of strychnine, while the dibasic salt contains 77.49 per cent.—(*Journ. Pharm. Chim.*, II., 289, 1921, and I., 92, 1922.)

POLYMERISATION OF LÆVOGLUCOSANE—*Amé Pictet and J. H. Ross*.—When lævogluco-
 $\text{no} \text{ H O}_3 = (\text{C H O}_3)_n$
 glucosane is heated to 140° in presence of a trace of zinc chloride, the reaction takes place in a few minutes, but different products are obtained, according to the pressure. If the pressure is gradually raised, the value of n increases from 2 to 4, 6 and 8. Thus a series of polyævogluco-
 sanes can be obtained comparable with the polyamyloses which bring about the progressive degradation of starch under the influence of *Bacillus macerans*. At a pressure of 15 mm. dilævogluco-
 sane is obtained; this differs from lævogluco-
 sane in that it is insoluble in acetone, from which it can be precipitated in the form of a white amorphous powder, fusing at 135° without decomposing. It is very soluble in water, acetic acid and pyridine, but insoluble in other solvents. At atmospheric pressure the product obtained by heating lævogluco-
 sane is tetralævogluco-
 sane, while at a pressure of 4.6 atmospheres the hexa polymer is formed. This differs from the other two polymers in being insoluble in pyridine. At 13.3 atmospheres the octopolymer is formed. Thus the polymerisation of lævogluco-
 sane at a constant temperature but at increasing pressures gives products the properties of which are more and more like those of the dextrines. This fact seems to be of interest in connection with the trans-

formation of sugar into starch in plants, the transformation taking place at high pressures, possibly higher than those employed in this series of experiments.

NOTES ON BOOKS.

Creative Chemistry, descriptive of recent achievements in mechanical industries, by EDWIN E. SLOSSON, M.S., PH.D. 311 pp. Illustrated. Hodder & Stroughton. University of London Press, 18, Warwick Square, E.C.4. Price 12s. 6d. net.

The author, in his book, aims at relating the modern development of chemical science in its widest aspect and in a popular manner, so that the importance of science to human existence may be readily grasped by the uninitiated. It has been shown again and again that the recent war has added a tremendous impetus to the development of chemical science in every industry.

The book is profusely illustrated, and a very great deal of prominence is given to the part played by chemistry in the war. The author's style is original and will most certainly appeal to the younger generation, particularly in America, for in many instances the progress of discovery is viewed from a decidedly American standpoint. The author divides the progress of chemistry into three periods—the appropriation period, the adaptive period, and the creative period—and at the end of this succession of eras he seems to expect the substitution of an artificial world for what we now know is the natural world, where "Man the Artifex will ultimately master nature and reign supreme over his own creation . . . until chaos come again." Not a very hopeful outlook certainly. In this connection the quotation from M. Berthelot is given where it is said that "the day will come when each person will carry for his nourishment his little nitrogenous tablet, his pat of fatty matter, his packet of starch or sugar, his vial of aromatic spices suited to his personal taste—all economically manufactured and in unlimited quantities, all independent of irregular seasons, drought and rain." In spite of this somewhat fantastic statement the various chemical processes met with in our common daily life are described in great detail.

The chapter on synthetic plastics gives a good idea of the author's style. We are told that Alfred Nobel once cut his finger, and daubing it over with collodion was led to the discovery of the high explosive dynamite, and that later on John Wesley Hyatt, the son of a blacksmith, got a sore finger and resorted to the same remedy, but when he got to the cupboard where the material was kept the bottle had fallen over and the collodion had run out and solidified on the shelf. "Possibly Hyatt was annoyed, but if so, he did not waste his time raging round the office to find out who tipped over that bottle. Instead, he pulled off from the wood a bit of the dried film—he found it tough and elastic. It occurred to him that it might be worth 10,000 dollars. It turned out to be worth many times that."

From these accidental discoveries followed celluloid, and later on the valuable compound of phenol and formaldehyde discovered by Dr. Baekeland and now called Baekelite, and many similar compounds that are rapidly becoming of the greatest value.

A very interesting chapter is devoted to the production of sugar from beetroot and the sugarcane. Chapter 12, which comes between one on fats and sugars and another on the products of the electric furnace, is devoted to poison gases and their use in the war. The chapter is, of course, interesting, but it seems rather out of place, and deals with a subject we would like to forget. The use of these gases made by Germany will remain to her everlasting disgrace, but it is a relief to turn from this chapter of chemistry to more reasonable developments of chemical science that are found at the end of the book—the discovery of the more recent steels and rare elements and their new compounds is described in an interesting manner, particularly with respect to tungsten and molybdenum alloys.

A good description is given of the discovery by Dr. Auer von Welsbach of the method of illumination known all over the world as the Welsbach mantle. The final chapter deals briefly with the discovery and properties of radium. At the end of the book the author has collected together a number of reading references, dealing with the literature included in each separate chapter, that will greatly help the development of the study of the subjects that have been treated in the book. This will

be found very useful both for teachers and for ordinary readers who are interested in the modern developments of chemistry.

J. H. G.

Chemical Technology and Analysis of Oils, Fats and Waxes, by Dr. J. LEWKOWITSCH, M.A., F.I.C. Sixth Edition, entirely revised by George H. Warburton. Vol. II. McMillan & Co., St. Martin Street, London. Price 42s. net.

The work of Dr. Lewkowitsch on the above subject is too well known to need any remarks, and the chemical world will certainly welcome the appearance of the second of these most important volumes. The book occupies close upon 1,000 pages, is thoroughly well illustrated, and contains a deal of valuable tabular matter.

The first portion of the present volume is devoted to the commercial preparation of the raw materials in the oils, fats and wax industries, and the next chapter gives the technology of the natural materials, their method of preparation and refining, and the name of the product is given in English, French, German and Italian. A very large number of oils and waxes are indexed, occupying some six pages, and a full description is given of the source, properties, and chemistry of each species.

The book is very thoroughly illustrated and indexed, and will remain a standard book of reference on the subject for a long time to come.

J. H. G.

PLATINUM.

BY GEORGE F. KUNZ.

(Continued from Last Week).

In spite of the marked distinctions noted above, the discovery of platinum in the Ronda district by Senor Orueta resulted from his comparison of the eruptive rocks here with those of the platiniferous deposits of the Urals, as they had been described in 1911 by Prof. Duparc. This caused him to arrive at the conclusion that the peridotites of the Ronda district were also platiniferous. He therefore examined the alluvials of the rivers which traverse these peridotite masses, and he was rewarded in 1915 by finding platinum in all those which he tested.

TECHNOLOGY AND BIBLIOGRAPHY.

The production of platinum, having a higher degree of purity than has heretofore been attained, has been realised lately by the Bureau of Standards. It is claimed that Heraeus platinum,¹ long regarded as the standard for apparatus which requires the highest degree of purity, has been surpassed. This has been made possible by exercising a rigid control in the operation of smelting so that any calcium admixture can be almost entirely removed, as this admixture affects some of the physical properties of platinum.

Extremely fine platinum wire, of a type that in pre-war times was mainly produced by the Germans, is now manufactured here by an American company.² A platinum core is embedded in a silver wire, and after the wire has been drawn out until it becomes very fine, the silver is removed by acid. The platinum wire that remains is of extraordinary fineness, being only 0.00006 in. in diameter. With a trifle less than 50 troy oz. of platinum (1,555 gm.) it would therefore be possible to make a wire that would girdle the earth at the equator.

A new use of platinum has been noted by Donald W. Howe in an address before the Rochester section of the American Chemical Society. This concerns the employment of the metal as a hardener of vegetable oils. For this purpose "platinum black" is used, the material obtained by chemical combination of platinum with muriatic and nitric acid, and burning of the resulting platinum chloride on asbestos. The action of platinum black on the oils is similar to that produced by nickel.

The most authoritative and complete work on platinum and platinum deposits has very recently been published in Geneva by Louis Duparc, professor of mineralogy and petrology in the University of that city. Associated with him in the authorship was Marguerite N. Tikonovitch.³

¹*Op. cit.*, p. 254. Also Don Domingo de Orueta, "Resultado practico del estudio petrographico de la Serrania de Ronda," *Revista Miniera*, Nov. 8, 1915.

²*Chem. Met. Eng.*, Apr. 20, 1921.

³Louis Duparc and Marguerite N. Tikonovitch, "Le Platine et les Gîtes Platinifères," Geneva, 1920, 600 pp., text ill., 90 stereotype pls., 11 in black and colour, 8 of dredges, etc., atlas of Ural deposits, etc. Published by the Société Anonyme des Editions "Sonor," 46, Rue du Stand, Geneva; see also *Science*, N.S., 51, 399-403, Apr. 23, 1920.

No one could be better qualified to execute this task than Professor Duparc, who has long been known as the writer of many papers on the great platinum deposits of the Urals region in Russia, of which he has made a special study. He has also investigated personally the notable platinum deposits in other parts of the world, and the present work embodies the results of over twenty years of careful investigation as to the sources and exploitation of this rare and useful metal.

The work opens with a very comprehensive study of the topography and geology of the Ural region; this leads up to a chapter on the various "mother rocks" of platinum, and to a full description of the primary platiniferous centres, namely the dunites and peridotites, and to notes on the pyroxenites and koswites, as well as on the rocks of the gabbro family and other vein rocks, and on the metamorphic rocks which appear in the eruptive platiniferous zone. Then the constituent elements of native platinum are presented, the condition in which it is found in the deposits, and the probable origin of the latter. To this succeeds a chemical section, giving a number of analyses of platinum ores and detailing the methods used in these investigations. The secondary deposits and the platiniferous alluvials are then passed in review. Following the exceedingly full description of the Uralian deposits, Professor Duparc more briefly treats of the platinum deposits in other parts of the world, in San Domingo, Honduras, equatorial Colombia, Brazil and French Guiana, in the United States, and in Mexico and British Columbia. Details are also given regarding the deposits of Oceania, Borneo, New South Wales, New Zealand, and Tasmania. The African deposits of the Transvaal are noted, as are the claims that Madagascar is a platinum producer.

The metallurgy of platinum and the methods used for the extraction and separation of the various metals of the platinum group are given at considerable length. To this very naturally succeeds a presentation of the different uses to which these metals have been put, and the work concludes with a chapter of statistics of platinum production. The first 100 copies of this great work were not in trade, and for each of the 500 copies numbered 101 to 600, subscribers were charged 100 francs, the price through booksellers being 125 francs. It must be

borne in mind that these are Swiss francs, with only about 10 per cent. discount.

Another important publication in the platinum field is a new edition of the valuable bibliography of platinum literature by Prof. James Lewis Howe. The first edition appeared in 1897, and was exclusively the work of Prof. Howe; in this second edition he acknowledges his indebtedness to a continuation by Dr. Hendrick Coenraad Holtz, then of Amsterdam, who carried the work down to 1910. This supplementary matter was completed by Prof. Howe, and all the literature was included up to 1916. A comparison of the number of titles given in these two successive editions of the bibliography will show how much more complete the second is than the first. In the edition of 1897 there were in all 2,440 titles, but in that of 1917 the number is increased to 4,561, not far from double. The titles are given in chronological order, those of each year being separately numbered. There is a complete, alphabetical author-index, which covers 29 pages, the literature for each subject being listed in chronological order, with the year and the author's name, as well as the year number under which it appears in the bibliography.¹

Due notice is taken in the bibliography of the annual platinum reports in "Mineral Resources" issued by the United States Geological Survey, where they have been treated successively since 1904 by David T. Day, F. W. Horton, Joseph Struthers, Waldemar Lindgren, and for the past 10 years by Dr. J. W. Hill. Companion pieces to these reports are the ones issued annually in our own publication since 1892, these having been furnished in the successive years by Charles Bullman, Henry Louis, Joseph Struthers, L. Tovey, Frederick W. Horton, F. Lynwood Garrison, and in the years 1916 to 1919 by the present writer, who also furnished the platinum data for the Eleventh Census (of 1890), with photographs he took while

studying the Uralian deposits, and who contributed to the *Bulletin of the Pan-American Union* for November, 1917, a paper entitled "Platinum: with especial reference to Latin America," as well as a paper on palladium deposits of Brazil in a later issue of the *Bulletin*.

Among the monographs issued by the "Imperial Institute" on the mineral resources of the British Empire, is one by A. D. Lumb on "The Platinum Metals." It contains a small-scale map of the world, on which are marked the positions of the various platiniferous districts treated of in the text of the book.

[Abridged report on the production of Platinum for the year 1920 from "Mineral Industry," Vol. XXIX.]

NOTES ON THE MANIPULATION OF OSMIRIDIUM CONCENTRATE.

By R. A. COOPER.

As a number of assayers and others now handle osmiridium in the ordinary course of their duties, it has been thought advisable to publish a note warning anyone concerned of the danger of coming in contact with vapours of the volatile compounds of osmium and ruthenium.

Roscoe states that "Osmium undergoes oxidation somewhat readily when finely divided, being oxidised and volatized when heated in air below 212° and in oxygen below 170°, but not below 155°.

"When strongly heated in air, oxidation of the compact metal also takes place, and this operation is attended with great danger owing to the formation of the highly poisonous tetroxide. Deville in this manner was rendered almost blind for 24 hours by having accidentally become exposed to the vapour of tetroxide. This substance produces the most violent pain and inflammation of the conjunctiva, and vision is permanently injured by the subsequent reduction of a film of metallic osmium.

"The tetroxide has a most powerful penetrating smell, somewhat analagous to that of chlorine and iodine. A very small quantity of vapour mixed with air attacks the lungs, giving rise to very serious inflammation of the mucous membrane. As an antidote to these effects Claus recommends the inhalation of sulphuretted hydrogen, which, however, must be cautiously employed.

¹"Bibliography of the Metals of the Platinum Group, Platinum, Palladium, Iridium, Rhodium, Osmium, Ruthenium, 1748—1917," by Jas. Lewis Howe and H. C. Holtz, Washington, D.C., 1919, 558 pp.; U.S. Geol. Surv. Bull, 694. The first bearing only Prof. Howe's name, was published by the Smithsonian Institution, Washington, D.C. 1897, 318 pp.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 10902 Benzus, J. Stopper for glass containers for ethyl chloride, etc. April 18.
 11257 British Cellulose & Chemical Manufacturing Co., Ltd. Manufacture of plastic materials. April 21.
 11236 Christopher, J. R. Apparatus for neutralising and drying sulphate of ammonia. April 21.
 11325 Cocksidge, H. E. Process and manufacture of a sodium compound and a composition containing same. April 22.
 11405 Dunstan, A. E. Treatment of liquid hydrocarbons. April 22.
 11037 Farbwerke vorm. F. Bayer & Co.—Manufacture of azo-dyes. April 19.

Specifications Published this Week.

- 177,820 Praymulla, A. W. Method of and apparatus for the extraction of soluble matter from powdered or crushed material or substances other than tanstuffs.
 177,839 Simpson, T. R.—Concentration of ores containing elemental sulphur.
 156,170 Koppers Co.—Manufacture of ammonium sulphate.
 156,190 Boehringer Sohn, C. H.—Process for the production of alpha-lobeline.
 156,245 Wohl, A.—Process for catalytic oxidation of hydrocarbons into carbonyl compounds or acids.

Abstract Published this Week.

Anthraquinone.—Patent No. 176,235. A new method of preparing Anthraquinone has been patented by Mr. F. W. Atack, of the British Alizarine Co., Ltd., Trafford Park, Manchester.

The product is obtained by condensing *o*-benzoylbenzoic acid with sulphuric acid of 75-80 per cent. strength. The process may be made continuous by continuous addition of molten *o*-benzoylbenzoic acid and by maintaining the strength of the sulphuric acid either by evaporation such as by blowing in air or by addition of oleum. The anthraquinone separates on cooling from the comparatively weak acid, and may be withdrawn periodically.

Messrs. Rayner & Co. will obtain printed copies of the specifications and forward on post free for the official price of 1s. each.

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CHEMICAL SOCIETY RESEARCH FUND.

A MEETING of the Research Fund Committee will be held in June next. Applications for Grants, to be made on Forms which can be obtained from the Assistant Secretary, Chemical Society, Burlington House, W.1, must be received on or before Thursday, June 1st, 1922.

All persons who received grants in June, 1921, or in June of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be returned by Thursday, June 1st.

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3241.

THE ROYAL SOCIETY CONVERSAZIONE.

MAY 17TH, 1912.

The "Black Soiree" of the Royal Society met with the usual success. There was a very good attendance of Fellows and their friends, and a large number of interesting exhibits. A short Lantern Lecture was given during the evening by the Lord Rayleigh, F.R.S., on the subject of the Aurora Borealis and its Spectrum.

Photographs were shown illustrating some recent spectroscopic investigations on the aurora, particularly its occurrence on ordinary nights in the South of England.

Amongst the more interesting exhibits were some remarkably fine specimens of native gold recently found in Devonshire. Casts of a large Gastropod found near Hastings, measuring seven feet in length; some interesting finds by the British School of Archaeology in Egypt, and a Clock designed by the late Lord Kelvin, which is now permanently fixed in the Hall of the Society. The following is the official description of a selection of the exhibits:—*The British School of Archaeology in Egypt.*

1. Wooden statuette of an Egyptian youth, VIth dynasty.

This is one of three statuettes of different ages, found in a tomb with an alabaster head-rest, giving the name of Ra-mery-ha-shetef. The anatomical detail is rendered with remarkable care, representing a youth of about sixteen years.

2. The Earliest Hebrew Papyri; and a Greek letter of 18 B.C.

These portions of letters and liturgical songs are dated by Greek documents found with them of the early third century A.D. The forms of letters resemble the stone inscriptions of the first century. The Greek letter of Dionysia is an unusually perfect example.

Radiological Branch, Research Department, Woolwich.

Metal X-ray Tube, water cooled, with Iron Target.

The tube is of the hot cathode type, and is constructed chiefly of metal—the insula-

tion between the anode and the case being secured by a glass sleeve. Both the anode and the metal case are water cooled. The tube is self shielding—only a narrow pencil of X-rays escaping from an aluminium window.

The tube is designed to give the characteristic radiation of iron, and to run continuously with a heavy current.

Department of Zoology, Natural History Museum. (Mr. C. Tate Regan, F.R.S.)

1. Giant Frogs—*Rana goliath* and *R. guppyi*.

R. goliath, from S. Cameroon, is the largest known frog, attaining a length of nearly 12 inches, without the limbs; the exhibit shows a specimen eating a rat (*Lemniscomys striatus*). *R. guppyi*, from the Solomon Islands, feeds almost exclusively on crabs (*Cardisoma* and *Sesarma*), which are swallowed whole.

Mr. George H. Gabb.

The original portrait of Galileo by Justus Sustermans, in oil, painted for the Pandolfini Palace at Florence, when Galileo was about 75 years of age.

He is represented seated in a chair, holding a vellum telescope in his right hand.

This may be regarded as the most faithful and noblest portrait of Galileo, and probably the last done of him. It is mentioned in Waagen's "Art Treasures of Great Britain," 1859, as being then in the Methuen Collection.

Department of Geology, British Museum (Natural History).

A Gigantic Freshwater Gastropod from Wealden Rocks.

Found during the construction of a new road near Silver Hill, Hastings, close to the quarry known as the "Iguanodon Necropolis," in beds of the Wadhurst Clay Series. These beds, originally a blue calcareous sandstone, have mostly been altered by percolating water to a rusty brown sand-rock.

The internal casts shown occurred in association with ordinary concretionary masses, for which they were easily mistaken when only portions were visible. They differ, however, in being regular logarithmic spirals (right and left-handed), and in other ways. The big right-handed spiral was complete when found, but suffered loss through blasting operations, and the removal of portions by unauthorised persons

Enough has, nevertheless, been recovered to enable a restoration to be made. Twenty-three whorls, including the body whorl, are traceable, with a total length of 7 ft. 3 ins. The affinities of the mollusc are probably with the Tiaridae (*olim* Melaniidae), rather than the estuarine forms of Cerithiidae.

Mr. A. A. Campbell Swinton, F.R.S.

Radio-telegraphic Records.

These are specimens of the results obtained by several different methods of recording wireless signals, as follows:—

(1) Photographic records from a String Galvanometer directly connected in the aerial circuit.

(2) Photographic records from a Sensitive Manometric Flame caused to dance to telephonic sounds.

(3) Records by Siphon Pen and Morse Inker, actuated by Brown Relays and Crystal Detector.

(4) Records by Siphon Pen actuated by Thermionic Valves.

(5) Creed perforated Tape obtained with Thermionic Valves, and resulting print in Roman type.

The String Galvanometer records were obtained in 1910 in Copenhagen, with signals sent from Tralee, in Ireland. All the others were taken in London, some of them before the war, from sundry transmitting stations, many of which were in different parts of Europe, the most distant being Moscow.

Prof. W. T. Gordon.

Native Gold recently discovered near Torquay, Devon.

Gold has been recorded from several localities in Britain, but usually only in small quantities. The specimens so far obtained from this new locality are very rich, but the amount of material available is unknown, so that no idea of the value of the find can be given. The metal occurs in a crystalline condition, with dendritic habit, in the calcite cement of a fault-breccia near Hope's Nose, Torquay; and the specimens are quite striking when a fortunate fracture exposes the fern-like gold dendrites.

The Science Museum, South Kensington.

1. Original Microphones and Experimental Apparatus of David E. Hughes, F.R.S.

This original and historical apparatus was made and used by Professor Hughes in his experiments, which led him from the discovery of the microphone in 1878 to the transmission and reception of wireless signals in 1879. The original model of his induction balance is shown, as well as several examples of pencil and granular microphones; also his transmitting and receiving apparatus for wireless signals.

[Prof. Hughes exhibited his induction balance at the Royal Society's Convezazione on May 28, 1879.]

2. A Microscope with Geometrical Slides.

This model of a microscope upon geometrical principles was constructed by the late Dr. Keith Lucas, F.R.S., about 1896, and though roughly and cheaply constructed, the instrument is so designed as to permit such precise relative movements of the various co-acting parts of the instrument, that critical microscopic work can be carried out with it.

Mr. R. C. Gale and Capt. E. R. Macpherson.

Wrought Iron Currency from the Kisi Country, Sierra Leone Protectorate, West Africa.

This form of currency was in use prior to the establishment of the British Protectorate in 1787, and is of native workmanship. Analysis and photomicrographic examination show it to consist of wrought iron.

	%
Carbon	0.095
Silicon	0.103
Manganese	nil
Sulphur	0.024
Phosphorus	0.046

The photomicrograph ($\times 275$) taken at B, shows the typical ferrite crystals and slag inclusions found in wrought iron. The metal is soft and easily bent, the Brinell hardness at A being 121.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING—MAY 11, 1922.

Sir Charles Sherrington, President, in the chair.

The following papers were read, the summaries here printed having been supplied by the authors for use at the meeting:—

LORD RAYLEIGH, F.R.S. (1) A Photographic Spectrum of the Aurora of May 13-15, 1921, and Laboratory Studies in connection with it; (2) A Study of the Presence or Absence of Nitrogen Bands in the Auroral Spectrum.

(1) A photographed spectrum of the Aurora obtained on the night of May 14, 1921, is reproduced. It shows the negative bands of Nitrogen in considerable detail, also the green aurora line of unknown origin, which, however, is subordinate. A number of laboratory photographs of the negative bands of Nitrogen excited in various ways are reproduced for comparison.

With atomic ray excitation, and still better in the narrow positive column (capillary tube) at low pressure the development of the negative bands can be imitated, but Nitrogen spectra (line spectrum and second positive band spectrum) persistently appear in addition.

The cathode ray spectrum is free from these foreign spectra, but the negative bands produced in this way are not developed like those in the aurora, the intensity being much more concentrated in the first band of each group. Hard and soft cathode rays behave alike in this respect.

The auroral spectrum is also discussed in relation to the upper atmosphere. Assuming that helium is the main constituent above 130 kilom., as the theory of diffusion indicates, then it is difficult, on the hypothesis of positive ray excitation, to explain its absence from the spectrum of this particular aurora, which at Christiania reached to 470 kilom. Experiments on artificial mixtures indicate that it should be visible. With cathode ray excitation, this difficulty would be lessened, but the different development of the Nitrogen bands remains.

(2) Spectra of the "Northern Lights" taken in Shetland with the assistance of Mr. J. Crichton of the Meteorological Observatory there, are compared with spectra of the ordinary night sky at Terling, near London.

Most of the Shetland spectra show Nitrogen bands. None of the ordinary Terling spectra show these bands, though, owing to the long exposure given, the Terling plates show the green aurora line of unknown origin as strongly, or more strongly, than the Shetland spectra.

On the occasion of the great magnetic storm and world-wide auroral display of May 13-14, the Nitrogen bands were strongly developed at Terling. But this stands out in strong contrast to what is observed on ordinary nights.

C. CHREE, Sc.D., F.R.S. The 27-day Period (Interval) in Terrestrial Magnetism.

There is a tendency in terrestrial magnetism for disturbance to follow disturbance, and calm to follow calm, after an interval which is not an absolute constant, but does not depart much from 27 days. This phenomenon is investigated as displayed by the absolute daily range of declination at Kew Observatory from 1858 to 1900, and as exhibited in the international "character" figures from 1906 to 1920.

The phenomenon is clearly recognisable in almost every year of the long period considered. Generally speaking, it is more clearly exhibited in years when sun spots are few in number or are situated in low solar latitudes. The season of the year seems to have little, if any, influence on the phenomenon.

M. BARKER. On the Use of Very Small Pitot Tubes for Measuring Wind Velocity. Communicated by Mr. G. I. Taylor, F.R.S.

Dr. Stanton, in a paper published recently ('Proc. Roy. Soc.,' 1920, A), explains a method of calibrating a one-sided Pitot Tube which he uses for measuring wind velocities close to the walls of a pipe. The results of his calibration give a finite pressure in the tube when the opening becomes infinitely small.

In the present paper this experimental result is justified on theoretical grounds, and it is shown that the finite pressure in the tube for infinitely small openings is comparable with that at the nose of a sphere, of diameter equal to the breadth of the opening, placed in a stream moving with a velocity equal to that at the centre of the pitot opening.

The above result indicates a breakdown in the $p = \frac{1}{2}\rho v^2$ law for Pitot Tubes, when the dimensions of the pitot are very small or the velocity very low, ρ being the density

and v the velocity of the fluid and p the pressure difference. The present paper describes an experiment made to determine the value of re/ρ below which the $\frac{1}{2}pv$ law ceases to hold, r being the radius of the circular Pitot Tube and v the kinematical viscosity of the fluid.

The results show that, for values of $\gamma r/\rho < 30$, $p/\rho v^2$ is greater than $\frac{1}{2}$, and a curve of the usual "scale effect" type is obtained. Below this value, which incidentally is greater than the smallest used by Dr. Stanton in his experiments, there is a viscosity effect which shows itself in the form of an additional pressure comparable, as before, with that at the nose of a certain sphere.

E. T. PARIS. On Doubly Resonated Hot-wire Microphones. Communicated by Prof. H. L. Callendar, F.R.S.

The paper records the result of investigations into the properties of double resonators which can be used with hot-wire microphones in order to increase sensitivity and also, if desired, to widen the range of response. Two types of resonator are dealt with, namely:—

(1) The "Boys double resonator," consisting of a "stopped pipe" in series with a Helmholtz resonator. The theory is given and experiments are described which illustrate the results obtained.

(2) The "Helmholtz double resonator," consisting of two Helmholtz resonators in series. Rayleigh's theory is extended, and experiments are described, the results of which show a satisfactory agreement with the theoretical formulæ. The form of the resonance curves is discussed and the conditions affecting the sensitivity.

PROF. J. C. McLENNAN, F.R.S., and D. S. AINSLIE. On the Structure of the Line $\lambda = 6708$ Å of the Isotopes of Lithium.

In this investigation a study has been made of the structure of the lithium red line $\lambda = 6708$ Å by using a vacuum arc in the vapour of the metal, and by using both Lummer plates and a 30-plate échelon gratin crossed with a Lummer plate to effect the resolution.

It has been shown that with strong arcs the wave-length $\lambda = 6708$ Å consists of two doublets, with a separation of the doublet components of 0.128 Å and 0.165 Å respectively. The mean displacement of the two doublets was found to be 0.32 Å, which is between 3 and 4 times the displacement demanded on Bohr's theory for isotopes of lithium having atomic weights 6 and 7.

Attention is drawn in the paper to the results obtained by Merton and by Aronberg in studying the wave-length $\lambda = 4058$ Å, in the spectrum of ordinary lead, and in that of lead having a radio-active origin. In these experiments it was found that the observed difference in wave-length was between 80 and 90 times as great as the difference to be expected in Bohr's theory.

With both lead and lithium it seems that, in what would appear to be isotopic spectral displacements, the value found by observation is about the atomic number times the value obtained by calculation on the basis of Bohr's theory.

THURSDAY, MAY 18, 1922, AT 4.30 P.M.

Papers read:—

Prof. T. B. Wood, F.R.S., and J. W. Capstick, D.Sc. The Progress of Metabolism after Food in Swine.

J. A. Gardner and F. W. Fox. The Origin and Destiny of Cholesterol in the Animal Organism. Part 13.—On the Autolysis of Liver and Spleen. Communicated by Sir W. Fletcher, F.R.S.

C. G. Lamb. The Geometry of Insect Pairing. Communicated by Prof. J. S. Gardiner, F.R.S.

G. E. Briggs. Experimental Researches on Vegetable Assimilation and Respiration. XV.—The Development of Photosynthetic Activity during Germination of Different Types of Seeds. XVI.—The Characteristics of Subnormal Photosynthetic Activity resulting from Deficiency of Nutrient Salts. Communicated by Dr. F. F. Blackman, F.R.S.

Ernest Wilson. On the Susceptibility of feebly Magnetic Bodies as affected by Compression. Communicated by Prof. J. W. Nicholson, F.R.S.

S. F. Grace. Free Motion of a Sphere in a Rotating Liquid parallel to the Axis of Rotation. Communicated by Mr. G. I. Taylor, F.R.S.

LIST OF PAPERS FOR READING ON MAY 25, 1922.

Prof. C. H. Lees, F.R.S. The Thermal Stresses in Solid and in Hollow Circular Cylinders concentrically heated.

B. F. J. Schonland. On the Scattering of β Particles. Communicated by Sir Ernest Rutherford, F.R.S.

N. K. Adam. The Properties and Molecular Structure of Thin Films. Part II.—Condensed Films. Part III.—Expanded Films. Communicated by Mr. W. B. Hardy, Sec.R.S.

ROYAL INSTITUTION.

On Wednesday, May 24, at three o'clock, Dean Inge delivered the first of three lectures at the Royal Institution on "Theocracy"; the succeeding lectures will be given on Thursdays, June 1 and 8. On Saturday (May 27) Sir Hugh Allen begins a course of three lectures on "Early Keyboard Music," with musical illustrations by Harold Samuel. The Friday evening discourse on May 26 will be delivered by Professor W. E. Dalby, on "The Internal Combustion Engine: Its Influence and Its Problems," and on June 2 by the Hon. Maurice Baring, on "Gilbert and Sullivan," with musical illustrations.

PHYSICAL SOCIETY OF LONDON.

PROCEEDINGS AT THE MEETING HELD ON
APRIL 28, 1922, AT THE IMPERIAL COLLEGE
OF SCIENCE.

Dr. Alexander Russell, M.A., D.Sc., in the Chair.

"The Position of Best Focus in the Presence of Spherical Aberration," by T. Smith, B.A., F.Inst.P., National Physical Laboratory, was read by Mr. J. Guild in the absence of the author.

ABSTRACT.

Focal variations of phase in the presence of spherical aberration are calculated directly from the axial intersection points of rays of known inclination, and the graphical method employed shows that the focus for which phase variations have a minimum value may be found and suitably interpreted when the finiteness of the wave-length is disregarded. The diagrams here employed for the representation of spherical aberration have advantages over the more usual diagrams in several important particulars, and it is suggested that the older forms should be abandoned.

"The Determination of the Absolute Stress-variation of Refractive Index," by F. Twyman, F.Inst.P., and J. Perry, was read by Mr. Twyman, who also exhibited the apparatus to which the paper refers.

ABSTRACT.

The paper describes a ready method of determining the stress-optical coefficients, the Hilger interferometer being employed.

Poung's modulus of elasticity and Poisson's ratio are determinable simultaneously.

"An Experimental Comparison of the Viscous Properties of (a) Carbon Dioxide and Nitrous Oxide, and (b) Nitrogen and Carbon Monoxide," by C. J. Smith, B.Sc., A.R.C.S., D.I.C., Imperial College of Science and Technology, was read by the author.

ABSTRACT.

The present paper is the result of an experimental investigation to determine the viscous properties of (a) carbon dioxide and nitrous oxide, and (b) nitrogen and carbon monoxide. Direct comparisons have been made in each case by observing the time required by a mercury pellet to force an equal volume of gas through a capillary tube, at atmospheric and steam temperatures. For the above groups of gases the times of fall for each gas are equal at 15.0 C., and 100.0° C., and hence, independently of any knowledge of the absolute viscosity, it has been proved that the viscous properties are identical over the above temperature range. The absolute viscosity has been obtained by comparison with air, and the mean area of collision deduced by using Chapman's formula.

An Optical Sonometer was exhibited in action by Mr. F. Twyman, A.I.E.E., F.Inst.P. (A. Hilger, Ltd.).

The object of this instrument is to furnish graphs of the pressure variation in sound waves. The sound is directed by a trumpet upon a celluloid membrane a fraction of a wave-length of light in thickness, which is silvered at a point between its centre and periphery. Rays from a point-light lamp are concentrated on the silvered surface, and are reflected thereby through an ordinary and a cylindrical lens on to a photographic strip carried by a spring-driven chronographic drum. The duration and incidence of the photographic exposure are controlled by adjustable devices revolving with the drum. The constants of the membrane can be determined by measuring its curvature with an interferometer when it is being stressed by gravity, pneumatic pressure or electrostatic attraction. Good sound records can be obtained so long as the pitch of the sounds investigated differs considerably from the resonance pitch of the membrane, which is of the order of 200 per second.

SOCIETY OF GLASS TECHNOLOGY.

A Meeting of the Society, held in the Chemistry Lecture Theatre, University College, Gower Street, London, W.C.1, on Wednesday, May 17th, 1922, at 3 p.m.

AGENDA:

1. Minutes.
2. Applications for membership.
3. To receive and discuss the following papers:—

(a) "Columnar Structure in Sandstone Blocks," by John Currie, M.A.

(b) "Some Practical Notes on the Manufacture of White Glass in a Tank Furnace," by F. W. Adams, M.Sc.

(c) "The Composition of Lime suitable for Various Purposes in Glass Making," by Miss V. Dumbleby, B.Sc., and W. E. S. Turner, D.Sc.

WORKS EXCURSION.

By the courtesy of the directors, a visit was arranged to the works of Messrs. J. Powell & Sons (Whitefriars), Ltd., Whitefriars Glass Works, Tudor Street, London, E.C.4.

THE ROYAL STATISTICAL SOCIETY.

At a Meeting of the Royal Statistical Society, which took place in the hall of the Royal Society of Arts, on May 16, the President, Sir Henry Rew, K.C.B., took the chair, and Dr. Major Greenwood opened a discussion on the Scientific Value of Life Tables.

Dr. Greenwood submitted that the value of a life table as an instrument of research had been somewhat over-estimated, and that the opinion that important deductions could be drawn from local life tables which were not deducible from the death rates at ages was mistaken. A life table was an artificial product; its population was a fiction. It was not correct, for instance, to say that the average length of life of an English male was given by the "expectation of life" of any national table.

An "expectation of life" was deduced from the rates of mortality of contemporaneously observed lives and the comparison of such constants for different life tables was open to numerous criticisms. In the speaker's opinion, a Medical Officer of Health would learn little more from a life table than from death rates at ages.

NOTES ON THE MANIPULATION OF OSMIRIDIUM CONCENTRATE.

By R. A. COOPER.

As a number of assayers and others now handle osmiridium in the ordinary course of their duties, it has been thought advisable to publish a note warning anyone concerned of the danger of coming in contact with vapours of the volatile compounds of osmium and ruthenium.

Roscoe states that "Osmium undergoes oxidation somewhat readily when finely divided, being oxidised and volatilised when heated in air below 212° and in oxygen below 170° , but not below 155° ."

"When strongly heated in air, oxidation of the compact metal also takes place, and this operation is attended with great danger owing to the formation of the highly poisonous tetroxide. Deville in this manner was rendered almost blind for 24 hours by having accidentally become exposed to the vapour of tetroxide. This substance produces the most violent pain and inflammation of the conjunctiva, and vision is permanently injured by the subsequent reduction of a film of metallic osmium."

"The tetroxide has a most powerful penetrating smell, somewhat analagous to that of chlorine and iodine. A very small quantity of vapour mixed with air attacks the lungs, giving rise to very serious inflammation of the mucous membrane. As an antidote to these effects Claus recommends the inhalation of sulphuretted hydrogen, which, however, must be cautiously employed."

"Osmium tetroxide also acts violently on the skin, causing a painful eruption which can be removed by the use of sulphur baths."

Sir William Crookes says that " . . . the deleterious effects of this body (osmium tetroxide) upon the lungs have not been exaggerated, and too much care cannot be taken to avoid inhaling it."

Ruthenium tetroxide is not readily formed from the metal by heating in air, but may be formed by the action of chlorine on solutions of potassium or sodium ruthenate prepared by fusing the metal with sodium peroxide, etc.

It is stated to be formed also when chlorates are added to acid solutions or when concentrated aqua regia solutions are boiled.

The tetroxide distils readily from heated solutions when proper conditions obtain.

The ruthenium tetroxide vapour has a yellow or reddish colour and an irritating odour resembling that of ozone or nitrous fumes. According to Gutbier and Ransohoff it does not attack the mucous membrane, but cannot long be endured, and may produce severe symptoms of poisoning.

There should not ordinarily be any need for an assayer to heat osmiridium concentrates in the air, but if any such need arises the operation must be carried out in a very well ventilated fume cupboard discharging all vapours to the outside air. The osmiridium concentrates obtained on the Witwatersrand are slightly but distinctly soluble in even somewhat dilute aqua regia, and the osmium contents of such a solution are readily expelled as osmium tetroxide by even moderate heating.

When concentrates, after panning and nitric acid treatment to remove the heavy arsenic, nickel, vanadium, chromium minerals, etc., are being treated with aqua regia to remove most of the gold, the acid should be very dilute and cold. It is never advisable to hold the face over the container, and it is necessary to conduct the operation in fume cupboards. Aqua regia attack should never be carried to extremes when cleaning up concentrates, as, apart from danger of dissolving osmium there is no clear-cut limit to the action of the acid. Gold is certainly dissolved the most readily by weak—say 10%—aqua regia, but as soon as a large proportion of the gold has dissolved, action takes place on the platinum and rhodium. Apparently the latter two metals exist in these concentrates in the form of an independent alloy as they dissolve together.

Concentration of the acid by evaporation at this stage results in the solution of appreciable amounts of iridium, osmium, and ruthenium. Unfortunately any of these rarer metals dissolved are liable to be lost as their recovery is not always possible to the assayer. The aqua regia solutions should always be evaporated to low bulk by steam, diluted somewhat, and treated with a considerable quantity of ammonium chloride to precipitate the platinum and iridium. After 24 hours the precipitate is filtered off and washed with a fairly strong solution of ammonium chloride and ignited to obtain the metals, while the filtrate is diluted and treated with sodium sulphite to recover the gold. It appears to be advisable generally to leave about 1% of gold

with the "osmiridium" to avoid dissolving much platinum, etc.

While discussing osmiridium it may be of interest to note that any estimate of the osmiridium content of a sample, based on the weight of the material left undissolved when the gold beads obtained by ordinary methods of assay are dissolved in dilute aqua regia, is liable to be misleading.

When a fusion is poured from the crucible, metals of the platinum group are all liable to be left to some degree adhering to the crucible, as they are not all alloyed with the lead but only held mechanically by it.

Hammering the lead button is another source of loss, while the changes during cupellation do not appear to have been investigated quantitatively. It would be natural to assume that osmium and possibly some ruthenium is volatilised during cupellation, but it is doubtful whether this is the case.

I have taken 0.1 gm. portions of the granular osmium + iridium + ruthenium metal free from gold, platinum and rhodium, and cupelled with silver, parted with nitric acid—warmed with dilute aqua regia—filtered off insoluble metals, ignited and weighed them. One such series gave the weights 0.138, 0.141, 0.140, and 0.131 gm. after this treatment; an average gain in weight of 37.5% due to oxidation of the metals. Very prolonged treatment with hydrogen at a high temperature was required to reduce the material to approximately its original weight.

With such material as Witwatersrand black sands (heavy sulphides, etc.) it is advisable to take a large portion of the sample—say 500 grams—dissolve all sulphides, etc., by feeding gradually into nitric acid, wash the residue well with water, and decompose silicates by hydrofluoric acid followed by hydrochloric acid.

There remains a small quantity of very heavy material, largely vanadium and chromium compounds, which is undecomposed by these reagents, and also a white powder, possibly diamond dust, which latter cannot be removed by fusion either with alkaline carbonates or with bisulphates. These minerals are best removed by very careful washing from beaker to beaker by a fine jet of water until all "osmiridium" is separated from base minerals.

CHEMICAL NOTICES FROM FOREIGN SOURCES

SENSITIVENESS OF SOME REACTIONS OF HYDROCYANIC ACID. *Thure Sandberg.*—Using Koltz's method of detecting hydrocyanic acid by the Prussian blue reaction, the author has shown that 0.023 mg. of HCN can be detected in 10cc. of solution (i.e., 1 : 434). With quinaeum-copper sulphate paper 0.005 mg. of HCN give a decided blue coloration almost immediately. 0.0025 mg. give a blue coloration after one minute, and 0.001 mg. give a faint coloration after two or three minutes. Faint blue colorations could also be obtained with specimens of flour which had been exposed to air containing HCN, although the specimens had been kept for a month and a half in paper bags after the action of the gas. Benzidine and copper paper gives a pale blue colour after seven seconds, if the amount of HCN present is 0.0039 to 0.0046 mg. per 100 cc. According to the author, quinaeum gives a better coloration and acts more quickly than benzidine, but the latter has the advantage of being a reagent which keeps better.—*Zeitschr. f. Analyt. Chem.*, 1922, p. 110.)

ELECTRO AND MAGNETIC OPTIC EFFECT OF LIQUIDS WHICH CONTAIN METALLIC POWDERS IN SOLUTION. *M. St. Procopiu.*—When liquids contain fine metallic powders in suspension they show negative birefringence both in electric and magnetic fields. The phenomenon does not disappear with the field, but there is a time of relaxation lasting two or three minutes for all metals except in the case of liquids obtained from mercury, when the birefringence disappears practically instantaneously. This is probably because the mercury particles in suspension are very small. Different liquids behave differently in a magnetic field, and there are indications that the phenomenon is due to the presence of traces of iron.—(*Comptes Rendus*, CLXXIV., 1922, 1170.)

ACTION OF THIONYL CHLORIDE UPON ACID ALCOHOLS. *E. E. Blaise and Mlle. Montague.*—When glycolic acid is gently heated over the water bath with at least two molecules of thionyl chloride, and the product is fractionated in vacuo, two substances are formed—the chloride of glycolic chlorosulphate $\text{Cl-SO-O-CH}_2\text{-COCl}$, and chloracetyl glycolic chloride $\text{CH}_2\text{-Cl-CO-O-}$

$\text{CH}_2\text{-COCl}$. The former is very readily decomposed when heated to about 180° , the products being SO_2 and chloride of chloracetyl. When treated with glycerine in presence of absolute ether, it yields the sulphite of glycolic anilide. This substance fuses at $140\text{--}141^\circ$; it is decomposed by water, is slightly soluble in alcohol in the cold and very soluble when heated. It is stable when heated in perfectly dry air, but loses SO_2 when heated in the atmosphere. The same decomposition occurs very rapidly when it is heated on the water bath with a little water, on evaporation to dryness a residue of pure glycolic aniline is obtained. Chloracetyl glycolic chloride can also be obtained by treating glycolic acid with chloracetyl chloride and heating the product thus obtained with thionyl chloride.—(*Comptes Rendus*, CLXXIV., 1922, 1173.)

STABILITY OF PERSULPHATES. *K. Elbs and N. Ncher.*—If the persulphates of potassium, sodium and ammonium are compared, it is found that the last is the least stable both when heated dry and in aqueous solution. This may be explained by supposing that the NH_3 is oxidised to N_2 . The aqueous solution of these salts is slowly decomposed in the cold, more rapidly at about 35° , and very rapidly on boiling. The decomposition is made slower by the addition of Na_2SO_4 , and accelerated by the addition of acid or a large excess of fixed alkali. NH_4OH accelerates the decomposition owing to the oxidation of NH_3 to N_2 . Direct sunlight very greatly accelerates the decomposition of these solutions.—(*Chem. Zeit.*, XLV., 1921, 1113.)

MODIFICATION OF SILICON SOLUBLE IN HYDROFLUORIC ACID. *W. Manchot.*—Moissan has already described this modification of silicon, but has not stated the circumstances in which it can be obtained. After many experiments the author has found that it is formed when a solution of silicon in fused silver is rapidly cooled by pouring it into cold water. Fused aluminium can be substituted for silver. In both cases part of the silicon is soluble in HF , while an insoluble portion is also obtained. The latter reacts very easily with oxidising agents. It is a light brown amorphous powder which takes fire in presence of chlorine or fuming nitric acid.—(*Ber. deut. Chem. Gesell.*, LIV., 1921, 3107.)

GENERAL NOTES

FLOGGING FOR DRUG SELLERS.

Colonel Burn asked the Home Secretary if the Government would support legislation introduced to authorise flogging and imprisonment without the option of a fine in the case of individuals convicted of carrying on the illicit drug traffic in this country, and deportation, in addition, if the offender was an alien.

Mr. Shortt replied: The question of taking further powers and strengthening the law is under consideration. The power to deport already exists, and is used whenever possible.

ZINC CONCENTRATES.

Captain Wedgwood Benn asked the President of the Board of Trade what was the quantity of concentrates and spelter received by the Government under the agreement with the Zinc Producers' Proprietary Association, Limited, Australia; what quantity had been sold; the total sum received from sales; and the profit or loss resulting from these transactions?

Sir William Mitchell-Thomson replied: The quantity of Concentrates and Spelter delivered to date is 836,000 tons and 5,000 tons respectively, of which 139,000 tons of Concentrates and 3,000 tons of Spelter have been sold. The receipts from sales amount to £443,500. The Zinc Concentrates and Spelter Trading Accounts as at 31st March, 1922, are in course of preparation, and the profit or loss cannot at present be stated. It is anticipated that the accounts to date will show a considerable loss.

STATE OF THE CHEMICAL INDUSTRY.

During a discussion on the Board of Trade vote, Mr. Baldwin gave favourable reports of a number of trades, including the coal trade, the iron and steel trades, the cotton, wool, hosiery and leather trades. The chemical trade, he said, was improving, both in heavy and fine chemicals, but as regarded engineering and machine tools the less said the better. The electrical trades were fairly busy, and the textile machinery trade had been very busy. He was hopeful for the future.

A number of members criticised the action of the Government in passing the Dyestuffs Act, and the Safeguarding of Industries Act, but Sir William Pearce pointed out if those Acts had not been passed it was quite certain that the organic chemical industry of this country would have disappeared, and there would have been no dyestuffs industry and no fine chemical industry here. It would be quite impossible, in the present condition of the German industrial situation, for these industries to exist in this country unless they received the protection of these two Acts. Very few people in this country realised how very powerful was the blast of the German opposition that had to be met. The dyestuffs industry in Germany had been treated with the same precision as their military work was treated by the German General Staff, and to-day the whole of the German chemical industries were controlled by one Board. For the industry in this country to stand up against these forces unaided was quite impossible, and therefore the Balfour of Burleigh Committee was right in its recommendation that, for the time being some protection must be afforded to these two industries. The German view was that they could afford to wait, and that the dyestuffs industry and the fine chemical industry in this country would be destroyed and we should be placed again in the position in which we were before the war, when we were dependent on foreign supplies. Not only the big German syndicate controlling the chemical industries, but the German Government had come to the conclusion that the organic chemical industry, including dyestuffs and fine chemicals, was one of the greatest assets they possessed. The same view was taken in America, but in this country we did not even yet realise the importance of these industries. It would be an enormous reproach to this country if British brains could not make these industries a success.

A London correspondent of the *Manchester Guardian Commercial* writes in this week's issue:—"Australian importers are crying out for catalogues of English goods and other publications giving details of our manufactures. News has reached London that American manufacturers are pouring literature of this sort into the Australian cities, and are thereby getting a good deal

of business which the importers would prefer to send to this country if they knew where to get the goods. In respect to many items, American catalogues and trade journals are the only publications the Commonwealth importers get in the English language, and business men on this side will realise what this means to American trade. I am informed that most of the public libraries in Australia would gladly place on their tables price lists and catalogues sent to them from this country, and if illustrated catalogues are sent so much the better. In the last six months the Americans have sent 620 lb. of trade magazines and technical literature to the Sydney public library alone. I understand that the manager of the Bank of Adelaide, 11, Leadenhall St., London, E.C.3, will forward to the Sydney library at stated periods any trade catalogues sent to him for the purpose, but I suggest that manufacturers should also send their lists direct to the various libraries, the addresses of which can be got from most good directories. The lists will be welcomed."

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH,

16 & 18, OLD QUEEN ST., WESTMINSTER,
LONDON, S.W.1.

The report described below has been published by His Majesty's Stationery Office for the Department of Scientific and Industrial Research. Copies, price 2s. (by post, 2s. 2d.) may be obtained through any bookseller, or direct from H.M. Stationery Office at the following address: Imperial House, Kingsway, London, W.C.2.

PHYSICAL AND CHEMICAL SURVEY OF THE NATIONAL COAL RESOURCES.—No. 1.

Correlation of Data for the Yorkshire Nottinghamshire and Derbyshire Coalfield.

The fuel Research Board of the Department of Scientific and Industrial Research has had under consideration for some time the question of the physical and chemical survey of the coal seams of Great Britain, but the unstable conditions which prevailed in the coal industry during and since the war have necessarily led to the postponement of the work of organisation. In the meantime, however, work has been in progress on the collection and correlation of the data already available. The amount of information that can be thus drawn upon

varies greatly in relation to the several coalfields. In the case of the Yorkshire, Nottinghamshire and Derbyshire coalfield, the records already in existence which have been collated are likely to gain considerable value by the correlation of the data in connection with corresponding seams in different localities. This report is accordingly published to bring together particulars and characteristics of the coal seams of the area.

Mr. E. W. Petter, Chairman of the Executive of the British Engineers' Association, Managing Director of Vickers-Petters, Ltd., and a member of the Executive Committee of the Industrial League and Council, has just returned from an extensive business tour in India. Interviewed by a Press representative, Mr. Petter gave some impressions of his visit.

"A tour such as I have just completed," said Mr. Petter, "is an education in itself. It makes one proud to belong to the British Empire. In that Empire we have untold wealth, and we, of this generation, have an unparalleled opportunity of developing it. We live in troublous times. As we make use of our chances we shall be judged.

"Industrially, India is developing very rapidly. Particularly is this the case in the textile, engineering, and porcelain industries. Many of the factories I visited in various parts of the country are wonderfully organised. It is doubtful, indeed, if the porcelain idols which are now made in India could be better made in Germany, from which country they were almost all imported before the war.

"Indian competition is very serious from our point of view. For the India operative has no restrictions on output, and no Trade Union regulations. He soon becomes skilled in the use of machinery, and he then goes ahead, working it to the limit of its capacity. India is now manufacturing everything she can within her own borders.

"In speaking of India, one has to remember that 90 per cent. of the population is agricultural. But with a population which numbers three hundred millions, the remaining 10 per cent. is by no means negligible.

"The Indian has certain grievances which will have to be remedied if the two countries are to work together in harmony. There are the social grievances, of which the chief is the alleged attitude of the official class towards the educated Indian.

There are the economic grievances, one of which is the belief that the British rigged the rupee exchange so that it fell from 2s. 9d. in 1920 to 1s. 3d. last year. And there are the many political grievances, all of which can be overcome by the exercise of a mixture of tact and firmness.

"On the other hand, where Indian administrators are in power, there is a tendency to allow corrupt methods to enter in which will have to be overcome. The Indian has not yet learned that the chief qualification the British official brings to his job is the most scrupulous honesty. On that depends his success."

NOTES ON BOOKS.

Plantation Rubber and the Testing of Rubber, by G. STAFFORD WHITBY, PH.D., M.Sc., A.R.C.Sc. Pp. XVI. + 560 + 8 plates. London: Longmans, Green and Co., 1920. Price 28s.

The extended use of automobiles has produced an increasing demand for rubber during the last few years. The supply of wild rubber was quite unable to meet this demand, and a vast extension of the plantation rubber industry has taken place, especially in the Eastern tropics.

The present volume, which is one of the Monographs on Industrial Chemistry, edited by Sir E. Thorpe, is a valuable contribution to the literature of the rubber industry.

The information it contains is very complete, and has been ably correlated by the author, whose task has been a difficult one, when it is recalled that important discoveries in this branch of applied science have been published in a very large number of journals, some of which are difficult of access for the general reader.

The author's difficulties are apparent by the frequent explanatory footnotes, and it is to be hoped that most of these will be incorporated in the general text in future editions.

In Part I. Dr. Whitby describes fully the preparation of rubber. It is pointed out that acetic acid is the best substance for coagulating the latex. The chemical nature of the resins, proteins and other substances which occur in rubber latex is also explained.

Part II. is devoted to the testing of rubber and the changes it undergoes on vul-

canisation. The technique of these tests is adequately and admirably described, but the author deals almost exclusively with sulphur in the vulcanising processes.

In the case of rubber products, little value is attached to the results of chemical analysis alone. The mechanical properties of the product are naturally of more importance in this connection.

The comprehensive bibliography adds to the value of this Monograph, which is indispensable to all who are in any way connected with rubber technology.

J. G. F. D.

Home Chemical Laboratory, by R. F. YATES. Pp. 127. London: Henry Frowde, and Hodder & Stoughton, 1920. Price 4s. 6d.

The author states that this book "has been prepared for those who wish to become acquainted with the great fundamentals of Chemistry," but from its contents and style it is obviously intended for enthusiastic students who desire to supplement their chemistry courses with experiments at home.

Part I. deals with the structure of Matter from the standpoint of the Electronic Theory, and the author then proceeds to describe various chemical processes. Part II. discusses the equipment of a small laboratory, and in Part III. directions are given for conducting a few experiments, and much space is devoted to mechanical devices.

The book has been most carelessly written, and abounds in errors, many of them serious ones. Some of the figures are bad and show the very defects of unobservant students' sketches that science masters always guard against. Thus, all delivery tubes are indicated penetrating far into the vessel from which the gaseous product is to be led. An absurd distilling apparatus is shown on p. 87, and fig. 41 indicates precisely the wrong way to pour hydrogen.

The "most practical" method for removing tops from bottles is stated (p. 112) to be by plunging a red-hot iron into kerosene, with which the bottle is filled the desired height!

Among incorrect symbols and formulæ may be noted:—Magnesium Mn , Mercury Hq , Sodium Nitrate $NaSO_4$, and Alcohol $C_6 H_{12} O_6$

To introduce the Electronic Theory and Atomic Numbers to young students as the author has done is excellent, but this book cannot be recommended because it contains so many serious mistakes. J. G. F. D.

The Analysts' Laboratory Companion, by ALFRED E. JOHNSON, B.Sc. Lond., F.I.C., A.R.C.Sc. I. Fifth Edition. Pp. IX + 176. London: J. and A. Churchill, 1920. Price 10s. 6d.

In this edition (the fifth), the author has adopted the International Atomic Weights for 1921, and has recalculated, where necessary, various factors and data. Other improvements are also noticeable. But the information on particular branches of applied chemistry are dealt with rather too briefly to be of adequate service, although industrial chemists would naturally consult special treatises rather than this handbook for detailed information on any branch of the subject.

Analysts and works chemists will, however, continue to find this small but convenient Laboratory Companion very useful. J. G. F. D.

Electro-deposition of Metals, by DR. GEORGE LANGBEIN, translated, with additions, by WILLIAM T. BRANNT. Eighth edition, revised and enlarged. Pp. XII. + 863. London: Hodder & Stoughton, Ltd., 1920. Price 42s.

This eminently practical work has now reached its eighth edition, which will be as popular among those engaged in electroplating and allied industries as its predecessors have been.

Most important innovations have received due attention, but the author seems to have taken much of the new matter from a few journals rather than from the whole literature on the subject. The same applies to the types of plant shown.

The historical and the detailed practical sections are well done, and leave little to be desired except that temperature is still given in the Fahrenheit scale. Some of the definitions (e.g., that of "acids"), in the theoretical section, could be improved upon. Oxygen is given, instead of nitrogen, as a tri- or quinqui-valent element on p. 40.

An appendix contains useful electro-technical and general information.

The volume is primarily intended as a ready reference book and practical guide for the electroplater, but is also written from the scientific standpoint so that no reference library can afford to ignore it.

J. G. F. D.

SOCIETY OF DYERS & COLOURISTS.

Continued from May 12th.

We are long past the time of rule of thumb methods, and it is now more and more realised that the laboratory must work hand in hand with the producing side. The range of the chemists' activities is a fascinating one, not only on the industrial side, but also in the evolution of means of alleviating and preventing diseases to which all flesh is heir, and in the production of chemicals to assist an already bounteous nature. No industry affords better facilities than dye manufacturing for the development and training of chemists in this glorious work, and I am firmly convinced that British chemists are at least the equal of any chemists in the world.

I will now refer briefly to a few of the problems affecting our industry, and I cannot resist referring very slightly to a delicate subject, I might say a very delicate subject: that foundling known as the Safeguarding of Industries Act. This unfortunate foundling, discovered by Mr. Baldwin on the steps of the Board of Trade, has had during its short career on this uncharitable world a disastrous babyhood. Volumes have already been written on its diseases, and it has several times been operated upon by that well-known surgeon, the Referee, and I thin kwe may reasonably expect its early demise.

The Dyestuffs (Import Regulation) Act, 1920, which came into operation in Jan., 1921, deals with a most difficult and vastly complex problem. Many diverse views are held on this Act: the perspective entirely depends upon the spectacles one is looking through. The four main points of view to be considered are those of the Government and the Board of Trade, the British Dye Manufacturers, the foreign dyestuffs agents, and the users; and I will endeavour to put before you their respective views as they appear to me.

The Government still adheres to the opinion that for national security it is essential that synthetic colour-making factories should be maintained in operation in this country with their staffs of chemists and other experts. They are also of the settled opinion that this should be brought about without placing the textile and other colour-using industries in an unduly disadvantageous competitive position.

The British colour-makers' point of view is that without the Act they would be, if you will excuse me using the term, "wiped out," the depreciated mark at the present time making competition with the Germans absolutely impossible. They very naturally point out that the German Cartel, the "I.G.," in this event would practically have the market at its mercy and it could put up the prices, and seriously cripple the colour-using industries of this country. They also contended that so far they have not had a real chance to make good, as, owing to the large stock of German dyewares taken as Reparation, the stock that came into the country between the Sankey award and the passing of the Act, the large stock held by agents and users owing to the slump in trade, and the continued depression during last year, they have not had the advantage of the orders in bulk so essential for gaining experience and for economical production.

The Importing Agents for foreign firms naturally are against the Act, because it prevents them dealing with dyewares, except in a minor degree under licence; and so their means of livelihood are jeopardised.

The users, the most important body affected, view the whole subject with great anxiety and concern. Great Britain's textile trade alone, in 1920, represented over 50 per cent. of our total export of manufactured goods, and in 1921 over 40 per cent. Many colour users take the broad view that both for national and industrial security never again must the nation find itself in the terrible position it was in in 1914, but they ask that this should be brought about without placing them meanwhile in an unduly disadvantageous competitive position.

Others, I think a small minority, want to have the opportunity of taking advantage of the depreciated mark, and letting the future take care of itself.

Amidst all these divergent views it is essential that we must not lose the substance for the shadow. The export textile trade was built up on the quality and cheapness of its productions, and the trade will not regain its world supremacy until these two outstanding factors are re-established.

The quality of the dyestuffs played an important part in reaching that standard, and nothing should be done that will jeopardise our position in this respect.

We must be in the forefront in novelties and in the qualities of the dyewares ap-

plied to our textiles, and at the same time the prices for these wares must not be such as will retard the great efforts the textile trade is now making to re-establish itself in the world's markets.

This great nation during the war showed the world by its courage, its ability, its organising power, what it could do when hard pressed, it only needs the same unity, the same singleness of purpose to place the organic chemical industry on a plane equal to that of any other country.

Mr. Clare Lees (President of the Manchester Chamber of Commerce) proposed the toast of "The Textile Industry." He said:—The President referred to the Overseas Department over which Sir Philip presides, and I should like to add my voice to his, speaking on behalf of the commercial life of Manchester, not only in appreciation of the work of that Department, but in gratitude for the great assistance which it constantly renders to us. We are in constant communication with the Department, and we have received it in such a manner that it has always encouraged us to go again on any pretext whatsoever.

I do not think that anybody could suggest at the present moment that the textile industry is in a really satisfactory condition. If we compare the textile industry of 1913 with 1921 we find that we did not export in yardage, which after all is what matters to the working people of this country, more than one-half of our former production; and so we have a long journey to travel before we get full employment for our people, and after all that is the vital question for this country to-day. The cotton textile industries largely depend upon the condition of trade with India, and India has unfortunately fallen from her high estate in her transactions with Manchester. She bought very largely when goods were dear, and unfortunately something almost amounting to national repudiation took place, and the merchants of Manchester have been left with at any rate upwards of 30 million pounds sterling of bills that have not been taken up; and we in Manchester expect some settlement of those outstanding liabilities at the earliest possible date.

It must be remembered, and this is a thought on the brighter side, that no markets, whether they are rich or poor, will continue to buy on constantly falling prices. We have been going down hill in prices for nearly two years. Every time anybody has bought anything, by the time they got it

they wished they had not bought it. That process has been going on until the springs of legitimate speculation have dried up. Trade is very dependent upon speculation in its wise and legitimate form, and it is always a fact that speculation does enter as a corrective when markets are fluctuating by rises and falls. But when the fall is continuous you prevent that operation, and buying which in normal times would take off the temporary surplus in anticipation of better times, ceases. Values are fixed, after all, by a consensus of opinion, and the consensus of opinion has been that it was better not to buy. Now I suggest, and I think that this is a legitimate and a hopeful side to take, that that process cannot go on indefinitely. The time must come when the tide will turn, and as soon as ever the world realises that we have reached something like stability of values, perhaps with some slight tendency towards an upwards movement, those factors will again reassert themselves. There is another factor which has been of great disturbance to our trade, the poverty of Europe. We have ceased to buy food products to the extent of six million tons from certain groups of nations, and there has been a transference of four millions out of that six to another group of nations, and two millions we have not bought at all. In 1914 we derived 30 per cent. of those food products from Europe, and in 1921 that had fallen to 7 per cent. In 1914 we only derived 16 per cent. of those food products from the United States of America. In 1921 that had been raised to 32 per cent. Thus we have been forced to buy our food supplies from those nations that do not want, and will not have our manufactured articles. The result is that we are building up an increased indebtedness in that part of the world which is to our greatest disadvantage to be indebted to, and we are not able to send back in payment our manufactures.

There, I think, we have the textile trades' troubles more or less in a nutshell, and we are looking with earnest eyes and hopeful hearts to that great Conference in Genoa.

Speaking for a moment on the pending question of the wages in the cotton trade, what one has to bear in mind is the fact that the economic laws and moral laws are always ultimately in harmony. It is the function of the leaders of both sides to recognise this fact, and to translate it into concrete action. The markets of the world

are the ultimate arbiters of all questions of employment both in regard to quantity and to wages. If the cost of production is relatively higher than the value of the commodities which the world has to sell us, then they will either take less in quantity or we must take lower prices. It is the duty of employers to get the best wages the trade can stand for their work-people, and alternatively it is the duty of the workers to meet the facts of world commerce. The purchasing power of the overseas market and our costs of production must be equated before we can hope to have full employment. If both sides approach this question from this point of view, a speedy settlement of their outstanding differences will ensue to the benefit of the country as a whole, and such a settlement will redound to the credit of both sides. It is not a question of one side gaining an advantage over the other, but rather of all agreeing to act in the highest interests of the trade as a whole.

Col. F. H. McConnel (President of the Textile Institute) said:—One thing shines out above all others in these very troublous times, and that is the heroic way in which both masters and men have met their difficulties and smiled through them. Happily on a great many sides we can see signs of brightness. Stocks are being rapidly dissipated. From India, where there has been so much trouble in getting goods taken up, considerable orders are being placed, and there are other hopeful signs. But it is no use being optimistic unless we do our level best to earn the good times which are coming.

What we need is courage, confidence, and above all security.

The textile trade has its special difficulties. We know how the Indian Tariff is likely to affect, at any rate, the cotton industry. We know how the great export of machinery to India and to other parts of the world must have a serious effect upon the staple trades of this country. We have to meet that. We shall have to work hard to get over our difficulties. Sometimes the employers say, "Give us more production." No doubt production is an important thing, but its chief importance is the matter of reducing the cost of the articles so that they may be distributed over the world in greater quantities and with greater profit to the producers. Mere quantity can, however, be produced by those foreign countries who are getting our machinery

and have cheap labour. We must not be content with urging others to work and bring about more production, but we who have the leadership of industry must ourselves produce more from our brains, must try and raise the character of our industries and by enhancing the quality, by improving the design, by enriching the colouring of our textiles, provide work for the millions of producers. We may look with pride upon the way in which the workers have been working in this cruel time. In my opinion, great benefits can be secured by profit-sharing. In a concern of which I am a director, it has worked with extraordinary success, and there is a happy feeling between the workers and the employers which I attribute very largely to the Works Council and the Profit-Sharing Scheme, which has given them confidence that when good times come they will get their fair share of profits. It has also developed a real instinct for working with a better ideal of the functions of the worker, whether he be the manual worker or the man who works with his brain.

The Textile Institute, of which I have the honour of being President, is one which groups together the scientific work of the different textile industries. We have always pressed forward the work of research, and it is with the greatest pleasure that we see the establishment of the various Textile Research Associations. It can easily be seen that many things, such as power, mill-driving gear, fatigue, labour, etc., are practically identical in the different branches of the textile trade, and it is of the greatest importance that the Textile Institute links those together and tries to keep before it a high standard of what the textile industries should be doing; not only working for profit but working for the benefit of the workers as well as the employers. Attention is being paid by the Research Association to the details of the structure and the manipulation of the different fibres—cotton, wool, flax, silk, and so on—in a way that has never been attempted before and must lead to wonderful results in due time. But, in addition to those established fibres, there must be a great deal of effort made to produce improved artificial fibres, and it is up to the Society to do its part in enabling the best results to be got from all these fibres. To my mind, we should go about this in no insular way, but that all that is found out in this country, Germany, America and France should be worked together in the brotherhood of science.

Dr. M. O. Forster, in proposing the toast of "The President," referred to the Dye-

stuffs Importation Act, 1920, and said:—I confess quite frankly that my own sympathies are strongly in favour of the dyemakers, because I would go so far as to say this; that if the organic chemical industry of this country, which is represented mainly by the colour works, is allowed to go to the wall, if through any misinterpretation of the immediate economic requirements of the textile industry, that industry is allowed to die, then this country deliberately shuts itself out from any possible discoveries in chemistry, particularly organic chemistry, which may arise. That is a situation which no serious minded citizen of this country dare face. Think for a moment what that means. It means that such a revolutionary situation as occurred in 1856, when aniline dyes were first discovered, might easily arise during the next few years; and this country would have to follow the lead of Germany, France, or some other country which happened to come to the forefront in that direction. I say at whatever cost to even such an important industry as the textile industry, this country cannot afford to risk the colossal debacle following the loss of a revolutionary discovery.

The President suitably responded, and the proceedings terminated.

VENTILATION.

Two important papers on ventilation were recently read before the Institution of Mining and Metallurgy. The full papers can be consulted in the Library of the Institution.

The Index of the papers is given below:

Etude du régime des températures dans l'épaisseur d'un mur indéfini dont les deux faces sont soumises à une même variation périodique de la température. (Study of prevailing temperatures in the interior of an undeveloped wall, those two faces are subjected to the same periodic variation of temperature.) J. Seigle. — *Revue de l'Industrie Minérale*, St. Etienne, March 15, 1922, pp. 135-45. 8 francs.

Physiological principles governing ventilation when the air is contaminated with carbon monoxide. (Apart from one important exception, carbon monoxide is an inert and non-poisonous substance; experiments on men in six cubic metre chamber; observations in large gassing chamber; rule of half equilibrium value in one hour; comparative toxicity of pure carbon monoxide and other gases.) Y. Henderson and H. W. Haggard. — *Journal, Industrial and Engineering Chemistry*, New York, Vol. 14, March, 1922, pp. 229-36. 50c.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 11983—Baddily, J. Dyes of the anthraquinone series. April 28.
 11990—Moulder, C. H. Treatment of xanthorrhoea gums for production of dyes and stains. April 28.
 11589—Pettigrew, G.—Saturator for continuous production of neutral sulphate of ammonia. April 25.

Specifications Published this Week.

- 157,745—Brat, P. Process for recovering nitrogen in the form of ammonia and the like.
 165,767—New Jersey Zinc Co. Manufacture of zinc-oxide.

Abstract Published this Week.

Chemical Reactions.—Patent No. 156,438.—Mr. J. S. Morgan, of Messrs. Thermal Industrial & Chemical Research Co., Ltd., of 52, Grosvenor Road, London, has Patented a new method of effecting chemical Reactions.

Reactions in solid, liquid, and gaseous substances, which are liable to disturbance by exothermic heating, are effected by heating the finely divided substance or mixture of substances by passage through molten metal kept at a suitable temperature, by the rapid distribution of any locally-developed heat to the molten metal, undesired secondary reactions are avoided. Examples of reactions to which the invention may be applied are the destructive distillation of wood, the oxidation of methane to formaldehyde, and, according to the Provisional Specification, the distillation of calcium acetate, thus, finely subdivided wood such as sawdust or shavings are fed to a bath of molten lead at 350° C., and caused to travel therethrough by a rotating drum or by means of a travelling endless band, as described in Specification 174,974; a mixture of methane and air or oxygen is passed in the form of fine bubbles through molten metal heated to 350–400° C., preferably in the still described in Specification 170,617, the mixed gases being pumped into the hood and issuing therefrom as fine bubbles into the corrugations of the inclined plate.

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(3241)

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3242.

JOURNAL OF SCIENTIFIC INSTRUMENTS.

A preliminary number of a new publication, entitled the *Journal of Scientific Instruments*, has been sent to us for notice. It is proposed that the Journal shall be published by the Institute of Physics, and will be edited by E. H. Rayner, Sc.D., assisted by an influential Advisory Committee. The object of the paper is to assist the worker and user of instruments of precision, and it will deal exhaustively with the science of measurement.

The scheme was originated by Sir Richard Glazebrook, who realised the importance of the subject in Science and Industry.

The present issue contains a number of very important papers, reviews, abstracts of patents, and a very long list of "Articles in Prospect."

The "Foreword," by Sir J. J. Thomson, O.M., F.R.S., President of the Institute of Physics, which we have pleasure in publishing below, gives the aims, objects, and hopes of the new venture.

FOREWORD.

It has long been recognised by many workers that a journal dealing with methods of measurement and the theory, construction and use of instruments would have a great value as an aid to research in all branches of science and industry. There is at present no publication in the English language which covers this ground. Descriptions of instruments and methods of measurement are given in journals devoted to particular branches of science; but in such publications results are of primary importance, and little space can be afforded to descriptions and detailed drawings of instruments. It frequently happens that instrumental methods are valuable for researches of quite a different character from

that for which they were developed; and workers who may be interested in apparatus as distinct from results obtained never see the publication in question, even if they know of its existence.

It is proposed that a journal on the lines suggested shall be produced by the Institute of Physics, which will ensure that the management shall be absolutely independent. It will be managed by a Finance Committee appointed by the Institute, on which the Department of Scientific and Industrial Research and the National Physical Laboratory will be represented. The editorial work will be done at the National Physical Laboratory, assisted by a scientific Advisory Committee appointed by the Institute of Physics.

The expenses of the Journal will necessarily be considerable, as a high standard must be established and maintained, and it is doubtful whether receipts will cover expenditure, at any rate to begin with. Neither the Institute of Physics nor the Department of Scientific and Industrial Research has funds available to meet a deficit. Steps are being taken to raise a guarantee fund for the purpose.

Before it can be finally decided to publish the journal, it will be necessary to have some indication as to its probable circulation, and readers of this number are asked to notify their intention to subscribe on the accompanying form. It is proposed that the journal be issued monthly, and be similar in style to this preliminary number. The price will be 2s. 6d. (postage 2d. extra), or 30s. a year, post free.

It is estimated that with a circulation of about 1,000 there will be a deficit of some £2,000 per annum, while a circulation of about 3,000 will render the journal self-supporting.

Further particulars of the proposal are given later, together with specimen articles and a list of writers who have already expressed their willingness to contribute to the journal.

J. J. THOMSON,

President, Institute of Physics.

THE PREPARATION AND PROPERTIES OF ORGANIC STANNO- AND STANNI-CHLORIDES. PART IV.: SOME DIAMINE STANNICHLORIDES.

By J. G. F. DROGE, M.Sc., A.I.C.

The stannichlorides of *o*- and *p*-phenylenediamines have been previously described in Part II. of these researches (*Chemical News*, 1919, CXVIII., 90), where it was also stated that no double tin salt of *o*-phenylene-diamine had been isolated.

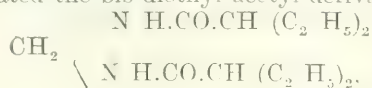
It has now been found that other diamines readily form stannichlorides, which exhibit the general properties of this class of double salts.

The corresponding stannochlorides have not been thoroughly investigated. They were not obtained by crystallising acidified aqueous solutions of the base and stannous chloride in molecular proportions. In the cases where crystals were obtained, these consisted largely of either the diamine hydrochloride or the stannichloride which was formed from the stannic chloride produced by oxidation of the stannous chloride on exposure to the air. Diamine stanno-chlorides appeared to be much more soluble than the corresponding stanni- salts.

It has been found possible to prepare stanno-chlorides of diamine bases by using solvents other than water. Results of experiments in this direction now in progress will be communicated upon completion.

The diamine stannichlorides are crystalline and dissolve in water with partial hydrolysis, giving acid solutions which deposit hydrated stannic oxide on keeping and on heating. They yield clear solutions with dilute mineral acids, and can be conveniently recrystallised from hydrochloric acid. Alkali solutions decompose them with liberation of the free base. Alcohols and acetic acid are the only common organic solvents that sometimes dissolve these substances.

The isolation of methylenediamine stannichloride has been accomplished, and from this substance the diamine hydrochloride was obtained, but the free base has not yet been isolated. Few simple derivatives of this substance are known. Einhorn and Maerumayer (*Ann.*, 1905, CCCXLIII., 316) isolated the bis diethyl acetyl derivative,



but nothing less complex appears to have been prepared previously.

The behaviour of hexamethylene tetramine towards chlorostannic acid, H_2SnCl_6 , was investigated in the hope that it might assist in finding a correct formula for this substance (compare Hahn and Walter, *Ber.*, 1921, LIV., 1,531).

Hydrazine Stannichloride $(\text{NH}_2)_2\text{H}_2\text{SnCl}_6$.

Hydrazine mono-hydrochloride (2.3 grms.) was dissolved in 50 cc. of hot dilute hydrochloric acid containing 11.7 grms. of crystalline stannic chloride. The solution was concentrated, and on cooling, thin colourless nacreous plates separated. These crystallised unchanged from dilute hydrochloric acid. The salt had not melted on heating, when a temperature of 300° had been attained.

On analysis,

0.5530 grm. gave 0.1170 grm. SnO_2 ;

Sn = 32.8 per cent.

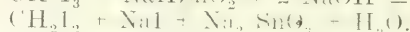
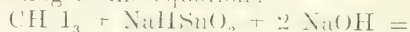
0.3668 grm. gave 0.8660 grm. AgCl ;

Cl = 58.35 per cent.

$\text{N}_2\text{H}_4:\text{H}_2\text{SnCl}_6$ requires Sn = 32.5 and Cl = 58.2 per cent.

Methylene-diamine Stannichloride, $\text{CH}_2(\text{NH}_2)_2 \cdot \text{H}_2\text{SnCl}_6$.—The methylene diiodide required for this preparation was obtained in 15 per cent. yield by the method described by Gutmann (*Ber.*, 1919, LII., 212).

Stannous chloride (2 mols.) was dissolved in sodium hydrate solution and iodoform (one mol.) was added. The mixture was gently heated under a reflux condenser for two hours. By this time the iodoform had been converted into methylene diiodide according to the equation:



Methylene diiodide was washed till free from alkali, and then distilled. The bulk boiled at $178\text{--}180^\circ$, and eight grams of this were mixed with 25 cc. of a strong aqueous solution of ammonia. The mixture was shaken periodically during several days until the diiodide had disappeared. The vessel was then unstoppered and gently warmed on a waterbath at $40\text{--}50^\circ$ to facilitate the evolution of the excess of ammonia.

The residual liquid was acidified and warmed with dilute hydrochloric acid containing 12 grams of crystalline stannic chloride. On cooling, a mass of fine crystals separated, which were quite distinct

from the octahedral ammonium stannichloride. When the salt was recrystallised it again gave a mass of small rhombic prisms. A small amount of the ammonium salt was obtained from the mother liquor. The salt dissolved easily in water, . . . but the solution hydrolysed on standing and on boiling. It did not melt when heated to 300°. On heating more strongly it decomposed, going slightly brown, with decrepitation and evolution of strongly acid fumes. A portion sublimed. When boiled with sodium hydrate solution it evolved an alkaline gas somewhat distinct from ammonia, which it closely resembled.

On analysis:—

0.5293 grm. gave 0.2062 grm. SnO_2 ;

Sn = 30.7 per cent.

0.3795 grm. gave 0.1514 grm. SnO_2 ;

Sn = 31.45 per cent.

0.3298 grm. gave 0.0456 grm. CO_2 and
0.1196 grm. H_2O ; C = 3.77 per cent.

and H = 4.03 per cent.

0.4500 grm. gave 1.0249 grm. AgCl ;

Cl = 56.3 per cent.

$\text{CH}_2(\text{NH}_2)_2 \cdot \text{H}_2\text{SnCl}_6$ requires

Sn = 31.3; C = 3.16;

H = 2.1; Cl = 56.5 per cent.

Ethylene diamine Stannichloride, $\text{C}_2\text{H}_4(\text{NH}_2)_2 \cdot \text{H}_2\text{SnCl}_6$.—Ethylene diamine hydrochloride (1.2 grm.) and stannic chloride (7 grms.) were dissolved together in 50 cc. of dilute hydrochloric acid. The solution was concentrated, and deposited very pale brown platelets which melted with decomposition at about 260°. The salt was readily soluble in water, giving an acid solution which became turbid on warming. When boiled with sodium hydrate solution ethylene diamine was evolved. The precipitate of *m*-stannic acid obtained dissolved in excess of the alkali.

In an attempt to prepare this salt from cyanogen, 5 grms. of silver cyanide were heated carefully, and the gas evolved was absorbed by 150 cc. of dilute hydrochloric acid containing 5 grms. of metallic tin. This solution was gently heated under the pressure of a few cms. of mercury until nearly all the tin had dissolved (20 hours). The filtered solution, which had a pale brown colour, deposited a small quantity of ethylene diamine stannichloride (0.8 grm.). The yield of the double salt was thus less than 12 per cent.

On analysis:—

0.7018 grm. gave 0.2832 grm. SnO_2 ;

Sn = 31.79 per cent.

$\text{C}_3\text{H}_6(\text{NH}_2)_2 \cdot \text{H}_2\text{SnCl}_6$ requires

Sn = 30.12 per cent.

Propylene diamine Stannichloride, $\text{C}_3\text{H}_6(\text{NH}_2)_2 \cdot \text{H}_2\text{SnCl}_6$. This salt was obtained from the constituent simple salts dissolved in dilute hydrochloric acid in the quantities indicated by the formula.

The pale grey-brown short prisms darkened on heating at 260–270°. They possessed the characteristic properties of stannichlorides.

On analysis:—

0.3335 grm. gave 0.1203 grm. SnO_2 ;

Sn = 28.41 per cent.

0.3162 grm. gave 0.6613 grm. AgCl ;

Cl = 51.7 per cent.

Sn = 29.16 and Cl = 52.2 per cent.

When a solution containing 4.52 grms. of stannous chloride and 3 grms. of propylene diamine hydrochloride in 100 cc. of dilute hydrochloric acid was concentrated $\text{C}_3\text{H}_6(\text{NH}_2)_2 \cdot \text{H}_2\text{SnCl}_6$ requires and cooled, crystals of diamine hydrochloride separated. The mother liquor, on keeping, gradually deposited crystals of the stannichloride.

Benzidine Stannichloride, $\text{NH}_2 \cdot \text{C}_6\text{H}_4 \cdot \text{C}_6\text{H}_4 \cdot \text{NH}_2 \cdot \text{H}_2\text{SnCl}_6$.—This salt has been obtained from the constituent chlorides using excess of stannic chloride. As stated by Barnes (*Chemical News*, 1919, CXIX., 13), this substance is most conveniently prepared by the reduction of azobenzene.

Azobenzene (6 grms.) was reduced with 7.2 grms. of stannous chloride and 80 cc. of concentrated hydrochloric acid, diluted with an equal volume of water, by heating on a water bath for 3 hours. On cooling, a mass of colourless needles was deposited. These dissolved readily in warm dilute hydrochloric acid, but separated again on cooling. The salt dissolved in water, but the solution became cloudy. With glacial acetic acid, it underwent some change, and a white precipitate appeared. Alcohol dissolved it, but it was insoluble in other organic solvents.

On heating, it began to darken at about 250°, but was still solid at 320°.

When more stannous chloride than that indicated above was used together with strong hydrochloric acid, azobenzene was reduced to a violet solution which gave crystals coloured slightly green. These were found to be aniline stannichloride (compare *Chemical News*, 1918, CXVII., 317).

No stannichloride of dianisidine



has been prepared.

When hexamethylene tetramine (3 grms.) was added to stannous chloride (9 grms.) dissolved in 100 cc. of dilute hydrochloric acid, much formaldehyde was evolved. On concentration, the solution yielded colourless crystals which lost water on heating at 100°. When warmed with sodium hydrate solution they evolved ammonia. The salt was found to contain 35.3 per cent. of tin; 42.6 per cent. of chlorine, and 10.1 per cent. of ammonia. This corresponds with the calculated percentages for ammonium stannochloride, $(\text{NH}_4)_2 \text{SnCl}_4 \cdot 2\text{H}_2\text{O}$.

By dissolving 3 grms. of hexamethylene tetramine and 14 grms. of stannic chloride in dilute hydrochloric acid, formaldehyde was evolved, and octahedral crystals of ammonium stannichloride separated when the solution cooled. Analytical results and other properties were in accordance with this conclusion.

The author's grateful thanks are due to Dr. A. Simek, Professor of Physical Chemistry at the Masaryk University, Brno, Czecho-Slovakia, who has secured the appended crystallographic data for the salts of propylene diamine, and *m*- and *p*-phenylene diamines, carried out by Prof. V. Rosicky.

Propylene-diamine-stannichloride:

Rhombic. $a : b : c$ 0.81800 : 1 : 0.67366.

Forms:

m (110) M^* G^{**} } prevalent; sometimes give good reflexions.
 o (011) $M.$, 01 $G.$

b (010) $M.$, 0 $_{\infty}$ $G.$ } narrow faces; b very often rather like a bright edge. Reflexions generally poor.
 r (021) $M.$, 02 $G.$

One circle goniometer measurements:

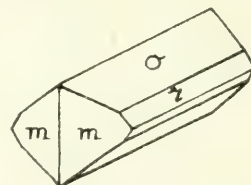
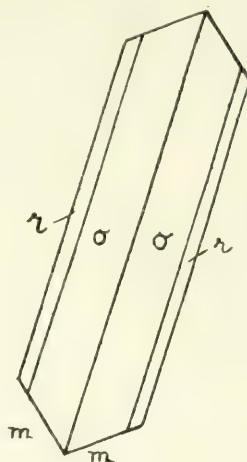
Measured. Calculated.

$m : m = (110) : (\bar{1}10) = 78^{\circ} 34'_{**}$ -
 $o : o = (001) : (0\bar{1}1) = 67^{\circ} 56'_{**}$ -
 $o : r = (011) : (021) = 19^{\circ} 29'$ 19° 27'
 $o : b = (011) : (010) = 55^{\circ} 58'$ 56° 02'

	ρ (measured).	s (calculated)
	ca. 0° 4' 89° 50' 0° 30'	0° 43' 90° 56° 43' 90°
o 01	0° 33° 58' 0° 33° 58'	
r 02	0° 53° 29' 0° 53° 25'	

$p_o = 0.821$.
 $q_o = 0.6747(2)$.

Cleavage perfect according to (001) and (110). Highly birefringent. On (001) no distinct figure in convergent polarized light. Extinction on (001) parallel to the edges $o : o$. No perceptible pleochroism.



PROPYLENE DIAMINE
STANNICHLORIDE.

p-Phenylene-diamine-stannichloride:

Rhombic, isomorphous with the foregoing salt. The crystals are less perfect, the faces reflecting badly, besides it was also broken and warped in general.

$a : b : c$ 0.8187(3) : 1 : 0.6747(2).

Forms:

m (110) M_{∞} $G.$ } prevalent.
 o (011) $M.$ 01 $G.$ } generally very
 b (010) $M.$ 0 $G.$ } narrow, like edges

One circle goniometer measurements:

Two circle goniometer measurements:

$$m : m = (110) : (\bar{1}10) = 78^\circ 37' *$$

$$o : o = (011) : (0\bar{1}1) = 68^\circ 01' *$$

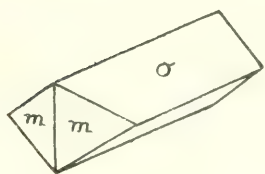
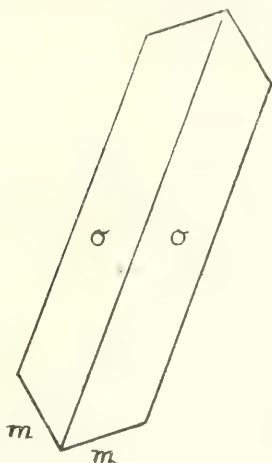
Two circle goniometer measurements:
(measured). (calculated).

$$o \ 01 \ 0^\circ \quad 34^\circ 01' \quad 0^\circ \quad 34^\circ 0\frac{1}{2}'$$

$$b \ 0 \infty \ 0^\circ 05' 90^\circ \quad 0^\circ \quad 90^\circ$$

$$m \ 50^\circ 46' 90^\circ \quad 0^\circ 41\frac{1}{2}' 90^\circ$$

Cleavage and optical orientation the same as in the foregoing case. Distinct pleochroism on (001) parallel to a, brown-yellow, parallel to b, lightly straw-yellow.



p-PHENYLENE DIAMINE
STANNICHLORIDE.

m-Phenylene-diamine-stannichloride:

Triclinic. $a : b : c = 0.49771 : 1 : 0.67061$,
 $\alpha = 110^\circ 14'$, $\beta = 99^\circ 47\frac{1}{2}'$, $\gamma = 96^\circ 15'$.

Forms:

b		(010)	M.	0	G. b, accor
m		(110)	M.	∞	G. ding to
a		(100)	M.	0	G. which the
c		(001)	M.	0	G. crystals
o		(011)	M.	01	G. are tabu-

lar, prevails. a, which is a very good cleavage-plane, further o and c give excellent reflexions. Of the faces b one is always better, reflecting perfectly and having a ribbed surface, the other is rugged (as marked by

small-pox) and reflecting always poorly (pe lial class?).

measured.

$$b : c = (010) : (001) = 68^\circ 10' *$$

$$a : c = (100) : (001) = 77^\circ 08' *$$

$$b : a = (010) : (100) = 79^\circ 33' *$$

$$a : m = (100) : (110) = 25^\circ 09' *$$

$$c : o = (001) : (011) = 39^\circ 21' *$$

$$a : o = (100) : (011) = 83^\circ 53'$$

calculated

$$p_o = 1.2718,$$

$$q_o = 0.66579,$$

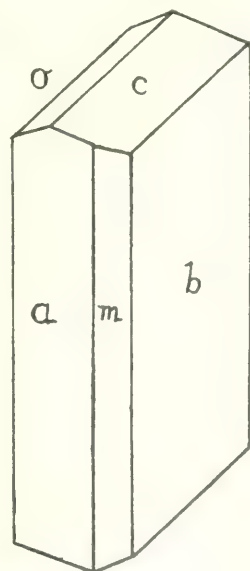
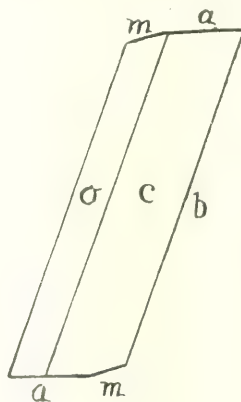
$$\lambda = 68^\circ 10', \mu = 77^\circ 08'$$

$$\sqrt{} = 79^\circ 33'.$$

$$83^\circ 58\frac{3}{4}' \quad a \quad b \quad c \quad 32^\circ$$

On b, 0 no distinct figure in convergent polarized light a black frame traverses the field. On a, 0, the acute bisectrix projects obliquely on the border of the field of view. One of the axes is visible near the border of the field, the other is passing already by it. The angle of optical axes is not too large. The extinction on b is oblique /, with respect to the edge b : c the angle is 32° against the obtuse angle β . On the cleavage face a the extinction is about 20° oblique to the edge a : b.

V. Rosicky.



m-PHENYLENE DIAMINE
STANNICHLORIDE.

* M = Miller.

** G = Goldschmidt.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, MAY 18, 1922.

SIR CHARLES SHERRINGTON, PRESIDENT,
IN THE CHAIR.

The following papers were read, the summaries here printed having been supplied by the Authors for use at the meeting:—

PROF. T. B. WOOD, F.R.S., and J. W. CAPSTICK, D.Sc. The Progress of Metabolism after Food in Swine.

Using a calorimeter recording electrically the main loss of heat by the animal, the authors have been able accurately to record the resting metabolism of a hog at intervals after feeding, varying from a few hours to six days. The results show that the excess of the resting metabolism above the basal, at any moment, is independent of temperature, weight, and age of animal.

This excess falls off according to the equation

$$\log y + \Lambda t = C$$

y being the excess, t time since meal, and Λ and C constants.

This equation is identical with that of Guldberg and Waage's Law of Mass Action, according to which the rate of decomposition of a substance at any time depends on amount of substance remaining undecomposed.

Simple analysis shows that this observation is consistent with the suggestion that the amount of the excess is dependent on the pressure in the body of a substance or substances, resulting from digestion and absorption of last or former meals, affecting the rate of metabolism, and in so doing being itself metabolised according to the mass-action law.

J. A. GARDNER and F. W. FOX. The Origin and Destiny of Cholesterol in the Animal Organism. Part XIII.—On the Autolysis of Liver and Spleen. Communicated by Sir W. Fletcher, F.R.S.

In a previous communication to the Society, the authors examined the intake and output of cholesterol in the faeces in the case of adults on normal diet, and found an excess of output over intake of about 0.3 grams per day. They, therefore, concluded that there must be some organ in the body capable of synthesising cholesterol. A similar view was put forward in 1913 by Gre-

gunt, who expressed the opinion that this synthesis was a function of the suprarenal glands, but without giving much evidence for his view.

In 1920, Abelous and Soula studied the autolytic changes in the case of liver, spleen, nervous tissue and other tissues and organs, and, without giving details of their methods, published figures showing that on autolysis, spleen, and to a lesser degree, nervous tissue and liver, have the power of synthesising cholesterol. This synthesis is increased by the addition of cholalic acid. In other tissues than those mentioned, the cholesterol is destroyed during autolysis.

The authors have studied the autolysis of pulped spleen and liver, during periods varying from one day to a month, and are quite unable to confirm Abelous and Soula's results. The cholesterol content of tissue remains quite constant, within the limit of experimental error, during autolysis, and the addition of pure cholalic acid has no effect. So far as autolytic experiments bear on the question, they afford no evidence whatever that the organs in question have anything to do with either the synthesis or destruction of cholesterol in the organism.

C. G. LAMB. The Geometry of Insect Pairing. Communicated by Prof. J. S. Gardiner, F.R.S.

The paper deals with some cases of asymmetrical hypopygium found in certain dipterous families, and in other orders of insects. It is shown that such asymmetry would necessarily result if the usual vertical position of pairing was adopted, subsequent to a primitive linear position, in which definite correlation of the genital tubes had been established.

Certain terms are proposed for use in describing the various stages of pairing, and the movements required, in order to avoid the existing ambiguities in accounts of the phenomenon.

G. E. BRIGGS. Experimental Researches on Vegetable Assimilation and Respiration. XV.—The Development of Photosynthetic Activity during Germination of Different Types of Seeds. XVI.—The Characteristics of Sub-normal Photosynthetic Activity resulting from Deficiency of Nutrient Salts. Communicated by Dr. F. F. Blackman, F.R.S.

XV.—In a previous communication, it was shown that the photosynthetic activity of the seedling leaves of *Phaseolus vulgaris* and of other plants is zero or very small for

some time after their appearance, whatever external factor was limiting. Results of experiments by various workers on the growth of *Helianthus* suggest that such is not the case in this plant under natural conditions of carbon dioxide supply. As the result of experiments, it was found that the seedling leaves of this plant showed practically full activity immediately after germination, both when light and when temperature were limiting. Other plants were tested: some were like *Phaseolus*, and others like *Helianthus*. The differentiating feature is that, in the type which shows the lag between germination and development of photosynthetic activity, the seedling possesses a specialised photosynthetic organ separate from the storage organ, whilst in the type where there is no lag, the same organ serves the dual purpose. Thus, specialisation in this case does not confer any advantage as far as an early commencement of assimilation subsequent to germination is concerned.

XVI.—*Phaseolus vulgaris* was grown on a culture solution containing all elements necessary for plant growth, and in culture solutions devoid of potassium, magnesium, iron and phosphorus respectively. The assimilation of leaves from the plants was measured by determining their output of oxygen.

Two types of determinations were made. In both the partial pressure of the carbon dioxide was such that this factor was not limiting the rate of assimilation. In one type the intensity of illumination was so small that light was limiting; in the other, the intensity was increased until the rate was limited by temperature.

Under both conditions the photosynthetic activity of plants grown on culture solutions devoid of some one element was less than that of plants grown on normal solution. In each case the depression was the same when light was limiting as when temperature was limiting. This was established for the pinnate leaves as well as the primary entire leaves. Compared with plants grown in pots, the plant grown on normal solution did not show reduced photosynthetic activity until the pinnate leaves appeared. Other cases of such coincidence of sub-normality in both photochemical and chemical phases of the photosynthetic process are found scattered throughout the literature.

To account for the facts, the suggestion is put forward that the factor inside the plant which is involved in the process is the amount of "reactive chloroplast surface." Such a conception of the nature of the process demands that activity should be sub-normal when carbon dioxide is limiting, if it is when light or temperature is limiting. Evidence that such is the case is produced.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, THURSDAY,
JUNE 1ST, AT 8 P.M.

The following papers were read:—

The reactivity of doubly-conjugated unsaturated ketones. Part III.—Unsymmetrical hydroxy- and methoxy-derivatives.—J. S. Buck and I. M. Heilbron.

Phenopyryllium salts of distyryl ketones. Part I.—J. S. Buck and I. M. Heilbron.

ROYAL INSTITUTION.

The Friday Evening Discourse on June 9 will be delivered by Mr. Joseph Barcroft, on "Physiological Effects at High Altitudes in Peru."

GENERAL NOTES

THE INSTITUTE OF BREWING RESEARCH SCHEME REPORT II.

Research work of the Institute from May, 1921, to March, 1922, gives a brief account of the work carried out by the Institute during the period named. The account deals with the breeding of new varieties of hops, curing, chemical investigations, etc.

Work has also been done on the examination of timber used for casks, by Professor Groom, and many suggestions are given as to the suitability or unsuitability of a given wood. Details are also given of investigations by Mr. Hulton on the evaluation of barley from the nitrogen standpoint, and much valuable detail is included.

RAW MATERIALS REVIEW.

A new journal devoted to the subject of Raw Materials. Edited by Dr. Edouard Luboff, F.R.E.S. The Journal is launched with a series of short commendations by prominent men whose names are associated with national progress and advancement.

The first number contains articles on Minerals of the Empire, Raw Materials of Peru, Hide trade in British Malaya, Paper Making, and other important subjects.

Leading articles are given, dealing with Prices, Trade Statistics, and Miscellaneous Information.

The new Journal fills a distinct want, and if future numbers are as full of interest and valuable information as the first issue, the founder and editor may be sure of successful appreciation.

BOARD OF TRADE ANNOUNCEMENT.
SAFEGUARDING OF INDUSTRIES
ACT.AWARDS IN ARBITRATIONS UNDER SECTION
1 (5).

Judgment has been given by the Referee in Arbitrations relating to the following complaints under the above Sub-section. The lists issued by the Board of Trade are amended in accordance with his Awards as from the 22nd May.

NATURE OF COMPLAINT.

(1) That Incandescent Gas Mantles are improperly excluded from the lists of dutiable articles.

(2) That Camphor (synthetic) and Pinene* are improperly included in the lists of dutiable articles.

JUDGMENT.

(1) That the lists be amended by including therein "Mechanical aggregates of Oxide of Thorium and Oxide of Cerium and of Nitrate of Thorium and Nitrate of Cerium being ingredients of Incandescent Gas Mantles."

(2) "That Pinene* and Synthetic Camphor be removed from the list, and that the words 'Komppa's Synthetic Camphor' be added."

* Note.—Pinene has already been withdrawn from the lists by the Board as from the 6th April.

Board of Trade,
22nd May, 1922.

Messrs. William Hodge & Co., Ltd., the publishers of the Notable British Trials Series, announce for early publication a volume dealing with the trial of George Joseph Smith. This trial is popularly known as the "Brides in the Bath" case, and may be said to be without parallel in the history of crime in any age or country. The editor is Mr. Eric R. Watson, Barrister-at-Law.

ROUTLEDGE'S MODERN CHEMISTRY.

Messrs. George Routledge & Sons, Ltd., are preparing a series of volumes designed for the use of post-graduate readers and others who desire to be informed accurately as to the precise state of knowledge in the several departments of Chemistry to which they refer.

The contributors are teachers and workers of experience, and each is engaged in research connected with the subject of the volume to which his name will be attached. The information supplied will, therefore, be as nearly as possible in harmony with the actual state of knowledge and opinion at the time of publication.

The series is under the Editorship of Sir William A. Tilden, D.Sc., F.R.S., Emeritus Professor in the Imperial College of Science and Technology, South Kensington; and Professor J. C. Philip, D.Sc., F.R.S., Senior Secretary of the Chemical Society, and Professor of Physical Chemistry in the Imperial College.

Arrangements have been made for the issue of the following volumes:—

The Metastability of Matter, by Professor Ernest Cohen, of the Van't Hoff Laboratory, University of Utrecht. This will consist of a complete study of the changes formerly included under the term "allotropy," and the redistribution of energy involved in the many curious transformations of matter concerned.

Oxidation and Reduction in Organic Chemistry, by Oscar L. Brady, D.Sc. (Lond.), B.A. (Cape of Good Hope), F.I.C. of University College, London. The most important methods and the chief modern reagents will be described, and results achieved will be systematised and interpreted on the basis of present knowledge.

Physical Aspects of Organic Chemistry, by Professor T. M. Lowry, C.B.E., F.R.S., of the University of Cambridge. Professor Lowry has for many years occupied himself in observing the physical changes accompanying chemical reactions, and in studying the physical properties of organic compounds. Much more work will have to be done on these lines before the constitution of the majority of organic compounds is understood.

Atomic and Molecular Structure in Relation to Properties, by Dr. Irving Langmuir, of the General Electric Company, Schenectady, N.Y. The generally accepted theory of the constitution of an atom appears to be that all elementary atoms agree on having a central positively charged mass surrounded by a planetary system of electro-negative electrons. From the chemical standpoint the Lewis-Langmuir atom is particularly interesting, and this volume will constitute an authoritative contribution to a much discussed problem.

The Energy Factor in Chemical Change, by Professor J. R. Partington, M.B.E., D.Sc., East London College. This subject has received comparatively little attention in this country, and Prof. Partington's volume will supply a general introduction. Readers who have but a moderate mathematical equipment will find this volume valuable as a guide in a highly important branch of modern chemistry.

Space Formulae in Carbon Compounds, by Professor Jocelyn F. Thorpe, C.B.E., F.R.S., F.I.C., Imperial College of Science and Technology, associated with Dr. Christopher K. Ingold, B.Sc. (Glas.), A.R.C.S. This treatise will include discussion of the new views which have arisen in connection chiefly with the experimental researches of the authors.

Adsorption, by Professor J. W. McBain, Ph.D. (Heidelberg), F.I.C., F.Inst.P., of the University of Bristol. The phenomena of Surface effects have attracted much attention in recent years, but so far no general treatment of the subject has been attempted. A systematic treatment by a well-know worker of the somewhat complex material involved will no doubt be welcomed in many quarters.

The Theory of Quantitative Analysis and its Practical Application, by Professor Henry Bassett, D.Sc. Lond., Ph.D.

Munich, D. es Sciences Nancy, F.I.C., University College, Reading. This volume will supply not only an account of the principle quantitative methods in actual use, but more especially the theory involved in such processes brought into harmony with modern views. Thus the strength of acids and bases, reaction velocities and the effects of various factors on solubility, &c., will receive special treatment and explanation.

THE BRITISH ENGINEERS' ASSOCIATION.

ENGINEERING AT THE BRITISH EMPIRE EXHIBITION, 1924.

The British Engineers' Association has been entrusted with the task of organising the Shipbuilding, Marine, Mechanical and General Engineering Section of the British Empire Exhibition, to be held in London in 1924.

The work of organising this important section and allotting space therein will be controlled by a special Committee composed of the President and Council of the Association, and a number of independent representatives of engineering industry.

Within the limits of the space available—about 238,000 square feet—every effort will be exerted to make the engineering exhibits representative of all that is best in modern British practice.

Full particulars, plans, and forms of application for space will be available for issue at an early date.

Enquiries should be addressed to D. A. Bremner, Director, The British Engineers' Association, 32, Victoria Street, London, S.W.1.

CHEMICALS AND "KEY" INDUSTRIES.

An interesting debate took place in the House of Lords last Tuesday, on a motion by Lord Beauchamp, to repeal the Safeguarding of Industries Act (which, among other things, places a duty on certain goods imported into this country, thus protecting "key industries"), on the ground that it interfered with trade and increased prices.

Lord Gorell, in reply, said that evidence showed that the Act had done much to encourage manufacturers in this country

not only to hold on to the position they had so precariously won, but also to undertake new developments. One old-established firm of chemical manufacturers had written:—"For many months our factories were working short time. Had we been ruthless we should long ago have sacked large numbers of our people. As a result of the passing of the Act we have been able to put our factories on full time and re-engage practically all the hands we had been compelled to dismiss. We have found it possible to set to work on research and experimental work on a number of new products, which we believe can be profitably developed in this country under the protection of the Act. Without such protection it would simply not be worth while to go into them, as the Germans would most certainly have swamped us as soon as we had developed anything which they saw was in the least profitable."

Another firm had written:—"The first effect of the passing of this Act on us as makers of fine chemicals was to establish our confidence. Profits which had been hanging fire owing to the doubt which existed whether or not the Government would or would not actually give the necessary assistance to the immature fine chemical industry were proceeded with when the Bill became an Act. We have undertaken the manufacture of a large number of additional chemical substances since the Act was passed, and in many cases these are already on the market; in others—and this refers more to large scale manufacture—plant is in process of erection, and will shortly be working. We have three additional buildings at present in course of erection, two of them approaching completion. We are employing additional chemists, junior chemists, skilled workmen, process workers and labourers. Both as regards actual manufacture we have new work in hand which would not have been commenced but for the passing of the Act."

There were many other reports to the same effect, but he thought those two extracts were sufficient to show that at any rate the Act had been beneficial in increasing employment and enabling new and struggling chemical industries to be developed. Only in a few instances had the Act resulted in an increase of price. There was evidence to the contrary, and a number of chemical manufacturers had deliberately

reduced their prices in order to take advantage of the Act and create a demand. This applied not only to chemical manufacturers, but also to certain classes of scientific instruments and scientific glass work. Further, the quality of some of the scientific goods made by British manufacturers was undergoing a marked improvement, notably with regard to the making of optical glass. In the short time it had been in operation, the Act had been a great success.

Lord Beauchamp's motion was defeated by 36 votes to 34.

Lieut.-Colonel Walter Guinness asked the President of the Board of Trade whether radium bromide was now subject to an importation duty under the Safeguarding of Industries Act; and, if so, whether he would take steps to remit this duty in the case of all radium for therapeutic purposes?

Mr. Baldwin replied: The answer to the first part of the question is in the affirmative. I have no power to take the action suggested in the latter part of the question.

CHEMICAL IMPORTS.

Mr. Baldwin informed Mr. Hogge that the following table referred to imports from October 1st to March 31st last:—

Commodity.	Quantity.	Unit of	Declared Value thereof.
Cream of Tartar ...	Cwts.	2,755	14,760
Tartaric Acid	Cwts.	1,311	7,608
Citric Acid	Cwts.	122	1,618
Acetic Acid (including Acetic Anhydride)	Tons.	1,541	42,353
Vinegar and Acetic Acid for table use	Galls.	86,293	14,904
(R) Anthracene ...	Cwts.	—	—
Tartaric Emetic	Cwts.	139	844
Calcium Ferrocyanide	Cwts.	39	199
(R) Naphthalene ...	Cwts.	584	332
Sodium Permanganate	Cwts.	—	—
(R) Ammonium Phosphate	Tons.	83	4,662
Potassium Permanganate	Cwts.	418	1,086
Sodium Acetate ...	Cwts.	1,188	1,340

THE INSTITUTION OF ELECTRICAL ENGINEERS.

19th May, 1922.

The result of the ballot for the election of Officers and new Members of Council for 1922-23 is as follows:—

President, Mr. F. Gill; Vice-Presidents, Dr. W. H. Eccles, F.R.S., Mr. A. A. Campbell Swinton, F.R.S.; Honorary Treasurer, Sir James Devonshire, K.B.E.; Ordinary Members of Council, Mr. J. W. Beauchamp, Mr. R. A. Chattock, Mr. F. W. Crawter, Mr. D. N. Dunlop, Major K. Edgecumbe, Mr. A. F. Harmer, Mr. W. R. Rawlings.

THE GEOLOGICAL SOCIETY OF LONDON.

May 19th, 1922.

The following communications were read:

1. "The Lower Carboniferous Succession in the Settle District and along the line of the Craven Faults," by Prof. Edmund Johnston Garwood, Sc.D., F.R.S., V.P.G.S., and Miss Edith Goodyear, B.Sc., F.G.S.

2. "The Miocene of Ceylon," by Edward James Wayland, Assoc.R.C.S., F.G.S., and Arthur Morley Davis, D.Sc., Assoc. R.C.S., F.G.S.

A meeting of the Society was held on Wednesday, May 24th, 1922, at 5.30 p.m., when the following Lecture was delivered:

"Geological Notes on Western Greenland," by Prof. A. C. Seward, Sc.D., F.R.S., President.

NOTES ON BOOKS.

Food Values, what they are, and how to calculate them, by Margaret McKillop, M.A., M.B.E. Pp. VIII. + 171. 1922. Second Edition (Revised and Enlarged). London: George Routledge & Sons, Ltd., Broadway House, 68-74, Carter Lane, E.C. 4. 3s. 6d. net.

An Introduction to the Chemistry of Radioactive Substances, by A. S. Russell, M.A., D.Sc. Pp. XI. + 169. John Murray, Albemarle Street, W.1., 1922. 6s. net.

The Tutorial Chemistry. Part II.—Metals and Physical Chemistry, by G. H. Bailey, D.Sc. Lond., Ph.D. Heidelberg. Pp. VI. + 494. University Tutorial Press, Ltd., High St., New Oxford St., W.C. Fourth Edition, 1922. 7s. 6d.

DEHYDROTHIOTOLUIDIN: ITS ISOMERS, HOMOLOGUES, ANALOGUES, AND DERIVATIVES.

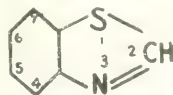
By MARTIN MEYER, B.Sc., M.A., New York City.

Introduction and Purpose.

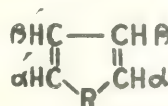
The chemistry of the organic sulphur compounds is one of the widest and most interesting divisions of the broad and attractive extent of the science, and in variety of properties, multiplicity of applications, and novelty of the reactions involved, is at least equal to, and certainly is excelled by no other. No matter what we choose as the criterion of our judgment we can meet all of the requirements without passing the boundaries of this field, be it medicinals, perfumes, dyes, explosives, or plastics, there is hardly a reaction that does not find its analogue, and in addition there are many here that can not be duplicated elsewhere.

In the chemistry of the dyestuffs, however, the sulphur compounds are pre-eminent. Of all the glorious colours which the chemist has contributed to mankind in his efforts to duplicate the iridescent beauty of the rainbow, the most beautiful and permanent are found in this group, the sulphides, the thioindigos, the thiazines, the thiazoles, and many others, the mere enumeration of which with their classes and sub-classes would fill a volume.

Among the most interesting of all from both academic and commercial standpoints are the five-membered nitrogen and sulphur heterocycles, more particularly the six-five bicyclic ones, or benzothiazoles. Of these the simplest is benzothiazole, or methenyl base as it is termed by Hofmann, to which the indicated structure is assigned. It may be observed that two



arrangements of the atoms in the smaller ring are possible. The nomenclature of the typical five-membered heterocycle is given by Richter as follows:—



and in this system all of the compounds mentioned herein are substituted benzothiazoles, the principal substitution being the incorporation of the alpha-beta carbon

atoms into a second benzol nucleus. The compound shown above is then benzo-beta-thiazole, and it is further suggested that for the sake of simplicity in nomenclature the positions in this be numbered as shown, which is also more in uniformity with the system applied to the thiazines and other heterocyclic compounds. This will be followed throughout this paper.

The homologues and derivatives of the compound just given offer a peculiarly attractive field for research, because of the variety of their properties and their commercial importance. To substantiate this statement without, at this point, going in too much detail, a few examples may be cited. By the fusion of benzanilide with sulphur, A. W. Hofmann prepared what he called benzenylortho-aminothiophenol, which in the system just recommended, is 2-phenyl-benzothiazole. The compound, wholly unlike any other known substance of its type, has a pleasant, highly aromatic odour, somewhat suggestive of tea-roses or geraniums, which led its discoverer to term it also "Rosenkörper." Some of the derivatives of this series are dyes. A. H. Green, on fusing paratoluidin with sulphur, found primulin and dehydrothiitoluidin, which are well known because of their practical value, since the annual production of direct cotton dyes exceeds all others, being closely rivalled only by acid wool colours, and all the dyes of this group are direct cotton colours.

The last-named two substances are formed simultaneously in the same reaction, and it is an odd coincidence that while immediately after the original work, the former was the important product, to-day the latter is the more valuable. Nevertheless, in recent years comparatively little work has been done, or at any event, has been published, with them, and up to the present no entirely satisfactory method has been developed for preparing dehydrothiitoluidin in a state of purity, and the discovery of one would probably make it an even more important intermediate than it is. Further study of the reaction by which it is formed is therefore highly desirable.

With this brief introduction, the objects of this dissertation may be stated as follows:—

1. To make some further contributions to the chemistry of the benzothiazole group.
2. To derive a relation between the thiazole structure and tinctorial value.

3. To determine the relation between the thiazole structure and odour.

4. To prepare pure dehydrothiitoluidin (6 methyl 2 para-aminophenyl benzothiazole) and to separate it from the primulin simultaneously formed.

Historical Review of Previous Work.

Although the volume of research which has been accomplished in this field is quite large, and the compounds important, most textbooks omit it entirely or dismiss it with a few lines, and even the original papers do not give much information about other work. No really acceptable summary of all of the work has ever been published, and, as it would be very useful to new investigations in the group, it is this which has led to the rather complete form in which the history is presented. Furthermore, the second and third objects of this investigation make a knowledge of what compounds have been prepared, and of their properties essential, and these are given at the end.

The credit for the discovery of, and original work upon the compounds of this group belongs to August Wilhelm von Hofmann (born April 8, 1818, died May 5, 1892), one of Liebig's illustrious pupils, and without whose work organic chemistry, as we know it to-day, would indeed be much the poorer. As his biographers, Jacob Volhard and Emil Fischer, whose pre-eminence in chemistry needs no further eulogy, say:¹

"Out of the great number of chemists who, come forth from Liebig's school in the second half of the last century, have made themselves useful as teachers and investigators in the broadening and advancing of our knowledge, August Wilhelm von Hofmann towers above all others in the number and importance of his discoveries, in the success of his teaching, in the fruitfulness of his influence on the chemical industry, and in the range of his directing influence as an author." Not the least among these were his researches upon the benzothiazoles.

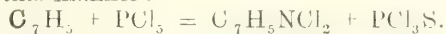
In 1874, Sell and Zierold² succeeded in preparing isocyan-phenyl-chloride from phenyl mustard oil by the direct action of chlorine. A few years later Hofmann³

¹Volhard and Fischer. *Berichte*, 35, 4502 (1902).

²Sell and Zierold, *Berichte*, 7, 1228 (1874).

³Hofmann, *Berichte*, 12, 1126 (1879).

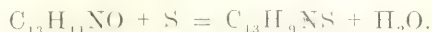
conceived the idea of making the same substance from the mustard oil, using PCl_5 , expecting that the reaction would take place in this manner:



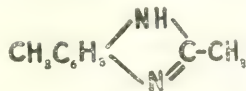
Upon actually performing the experiment he found that while some of the substance was indeed changed in this way, distillation of the reaction products yielded a portion boiling at 248°C . that contained a chlorinated mustard oil of a totally different type. The new substance was an oil of aromatic odour, B.P. 248°C ., soluble in alcohol, from which it was precipitated by water, and upon a complete elementary analysis as a basis he assigned the empirical formula $\text{C}_7\text{H}_4\text{NSCl}$ to it. It did not resemble in the least the compound for which he had been looking, and he proceeded to investigate its reactions. By acid hydrolysis he obtained $\text{C}_7\text{H}_4\text{NS(OH)}$ as a white solid (M.P. 136° , Jacobson later 139°), which exhibited phenolic properties, so he assumed the presence of an hydroxyl group. Dünner⁴ had previously prepared hydroxy-phenyl mustard oil which did not resemble this compound. The action of ammonia on the compound yielded the amine as an oil of aromatic odour, while aniline gave the anilide, a white, odourless solid (M.P. 159°). Although at this time he really did no work upon the structure of these substances, they were the first of the benzothiazoles, for as he showed later, they are all 2-substituted derivatives.

During the same year⁵ Hoffman became interested in a different type of sulphur compound. Merz and Weith⁶ had, by the action of sulphur on aniline, obtained a thioaniline which later proved to be identical with that prepared by Krafft⁷ who demonstrated that it was a phenyl sulphide. It occurred to Hofmann that if, instead of employing aniline, he used benzanilide, or as he called it, phenyl-benzamide, in place of $\text{NH}_2\text{C}_6\text{H}_4-\text{S}-\text{C}_6\text{H}_4\text{NH}_2$, he should obtain a benzoylated thioaniline. On actually performing the experiment he found a reaction quite different from his expectations, and prepared in this way a substance which crystallised from alcohol in colour-

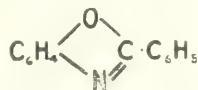
less needles (M.P. 115°C .) and had a pleasant, fragrant odour, resembling tea-roses or geraniums. Analysis indicated the empirical formula $\text{C}_{13}\text{H}_9\text{NS}$, and he showed the reaction by which it was formed to be:



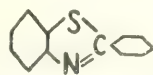
Hobrecker⁸ earlier had synthesized a compound to which he assigned the formula



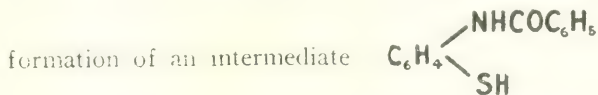
by reducing nitro-acetorthotoluidid, and Ladenburg,⁹ and later Wund,¹⁰ had prepared similar bases by the condensation of diamines with acids, and finally, studying the condensation of orthoaminophenols with acids, Ladenburg¹¹ had made a substance which he wrote



The analogy to his own case was immediately apparent, and Hofmann assigned the formula



to the "Rosenkörper." To establish this fact more definitely, he then proceeded to show that, as would be expected from its structure, it yields, on hydrolysis, ortho-amino-thiophenol and benzoic acid, and that it could be prepared from these two by the



This was the first compound of the group whose structure could in any sense be said to have been proved. He now went back to his original chlorphenyl mustard oil and repeated his work, adding some more, and preparing a number of new compounds listed at the end of the section. Then realising that his previous article contained no proof of the structure of the chlor mustard

⁴ Dünner, *Berichte*, 4, 465 (1871).

⁵ Hofmann, *Berichte*, 12, 2359 (1879).

⁶ Merz and Weith, *Berichte*, 3, 978 (1870).

⁷ Krafft, *Berichte*, 7, 384 (1874).

⁸ Hobrecker, *Berichte*, 5, 920 (1872).

⁹ Ladenburg, *Berichte*, 8, 677 (1875).

¹⁰ Wund, *Berichte*, 11, 826 (1878).

¹¹ Ladenburg, *Berichte*, 9, 1524 (1876).

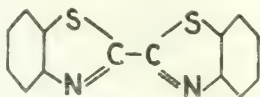
Ladenburg, *Berichte*, 10, 1123 (1877).

still further. By reduction with tin in concentrated hydrochloric acid, he obtained C_7H_5NS , a liquid, heavier than water and insoluble in it, soluble in ethyl alcohol and carbon disulphide, having a burning taste and a characteristic odour resembling somewhat that of the pyridines and the plant bases. It is isomeric with the mustard oils and thiocyanates and forms an addition product with methyl iodide which is soluble in water from which it crystallizes in colourless needles, M.P. 210° . The new base reacted with benzoyl chloride—



This compound proved to be identical with that which he had previously obtained by the fusion of benzanilide with sulphur, and established beyond reasonable doubt, the structure of the new substances, which he then named on this basis. By this method he contributed further new compounds listed at the end.

Up to this time the only general method by which the benzothiazoles could be prepared, which was recognised as such, was that by which the just mentioned ones were prepared, that is, the condensation of ortho-aminothiophenols and acids, acid anhydrides, chlorides, and amides, but also in 1880¹² he conceived the idea that the reaction by which "Rosenkörper" had been synthesized might be applied with appropriate changes to the synthesis of homologues. Immediately he proceeded to investigate the behaviour of anilides on fusion with sulphur, obtaining from formanilide a small amount of methenyl base or benzothiazole, from acetanilide slight quantities of ethenyl base, or 2-methyl benzothiazole, but much larger yields of a new substance which had the empiric formula $C_{14}H_8N_2S_2$, and to which he assigned on the basis of several syntheses the structure:

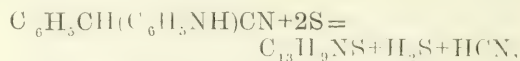


oxalaminothiophenol (2-bis-benzothiazole [M.P. 306°]). It crystallizes from alcohol in white needles although the solubility is very slight. No good proof of its structure was given, however, for several years.

Following this he prepared a number of the homologues of this compound, using the

dibasic aliphatic acids and ortho-aminothiophenol. Only a year later Hess,¹³ after having prepared the aminothiocresols, became interested in this general reaction, and using 3-sulphydroxy-4-amino-toluene contributed several new compounds which will be given later.

Interest in these new sulphur compounds now became quite general. Two years after the work just described, Tiemann and Piest¹⁴ succeeded in preparing the "Rosenkörper" by a new method, the fusion of phenylanilino acetic nitrile which they happened to be studying, with sulphur. They demonstrated that the reaction proceeded according to the equation:



and identified the product by its melting point and ultimate analysis.

Then in 1886 P. Jacobson¹⁵ published the first of a series of important contributions to the chemistry of the benzothiazoles. Thiobenzaldehyde had already been prepared by Klinger¹⁶ and from this thiobenzanilide, which was also prepared by Leo¹⁷ (and later by Gatterman—vide experimental part), by heating with aniline, but in repeating this work and studying the products of the reaction (stilbene and thiobenzanilide) Jacobson found also some of Hofmann's "Rosenkörper." The only explanation that he could give for its formation was that of oxidation of the thiobenzanilide, and to test the validity of his reasoning he oxidised a portion in alkaline solution with potassium ferricyanide and showed that about 60 per cent. of the product was the expected phenyl-benzothiazole. A new method of synthesis had been developed, for he recognised at once the generalisation that could be drawn from this experiment, and proceeded to prepare the 2-methyl-benzothiazole, and claimed to have obtained thioanilides, though in the case of the last mentioned, he was later disputed by Hofmann.

Apropos of the thioanilides a rather curious coincidence may be mentioned. Leo

¹³ Hess, *Berichte*, 14, 493 (1881).

¹⁴ Tiemann and Piest, *Berichte*, 15, 2033 (1882).

¹⁵ Jacobson, *Berichte*, 19, 1069 (1886).

¹⁶ Klinger, *Berichte*, 9, 1893 (1876).
Klinger, *Berichte*, 10, 1877 (1877).

¹⁷ Leo, *Berichte*, 10, 2133 (1877).

¹² Hofmann, *Berichte*, 13, 1223 (1887).

in a dissertation for his doctor's degree at Bonn, 1878, under the title of thioamides, described a substance which he prepared by the distillation of thiobenzanilid in the presence of air, and to which he assigned the formula $C_{27}H_{20}N_2S_2$. From his observations of the properties of the substance it was evidently the "Rosenkörper," and if his analytical work had been a little more accurate, and he had been able to appreciate the significance of his discovery, the credit for the original work in this field would have gone to him, for his work appeared several months before Hofmann's first paper.

In 1887¹⁸ Hofmann published some further work on the chemistry of this series. He treated ortho-aminothiophenol with carbon disulphide expecting to find a derivative of thiocarbamilid, but obtained instead a body whose empiric formula was $C_8H_5NS_2$ and which he showed readily was 2-sulphhydrobenzothiazole and could be prepared from chlorbenzothiazole and sodium sulphhydrate. By oxidation of this compound he made a 2:2 benzothiazole disulphide, shining, silvery plates from benzol, M.P. 180° (Jacobson later 186°), and by methylation the thioether, colourless prisms from dilute ethyl alcohol, M.P. 52°. The latter had an odour resembling that of benzothiazole itself, and also was quite similar to the ethoxy derivative already made.

¹⁸ Hofmann, *Berichte*, 13, 1788 (1887).

(To be continued.)

THE ACTIVATION OF HYDROGEN BY THE SILENT ELECTRIC DISCHARGE.

By Y. VENKATARMIAH.

Maharajah's College, Vizianagram, S. India.

Being curious to know the effect of the silent electric discharge on gases* other than oxygen, I submitted hydrogen to its action in the new ozoniser which was constructed in this laboratory. Hydrogen is of particular interest, as it is a monovalent element. Curiously enough, certain experiments, which were conducted by the author, afford a good evidence to believe that hydrogen undergoes polymerisation under the influence of the silent electric discharge.

* W. A. Shenstone, J.C.S.Tr. 1897, p. 487. 'It appears, therefore, that highly purified chlorine remains almost unaffected by the ozonising discharge.'

The hydrogen which was utilised in the

experiments was prepared by the electrolysis of a concentrated solution of barium hydroxide. The hydrogen thus prepared was passed over calcium chloride and phosphorus pentoxide, and then over lumps of potassium permanganate fused with potassium hydroxide and finally through the ozoniser. The whole apparatus was swept with hydrogen for some hours before the actual experiments were commenced. The ozoniser was worked by a powerful induction coil for the production of the silent electric discharge. After the hydrogen traversed the whole length of the ozoniser it passed over sulphur contained in a tube attached to the ozoniser. The hydrogen then finally passed over a strip of paper, in contact with a solution of lead acetate. In course of time the paper became black, showing thereby that the hydrogen from the ozoniser attacked the sulphur with the production of hydrogen sulphide. In a similar way it was found that phosphorus gave rise to hydrogen phosphide.

In order to confirm that the reduction of sulphur and phosphorus to hydrogen sulphide and to hydrogen phosphide respectively was not due to any other impurities in the gas, but the activated gas from the ozoniser alone, the gas from the drying and purifying chambers was passed directly over sulphur for a long time, but to no effect. Hydrogen from various sources was also tried, but no hydrogen sulphide was produced. It was also observed that any attempt to make the reactive hydrogen reduce sulphur after a few minutes of its activation was futile.

It is known that nascent hydrogen brings about reductions, but its action is only of a local character. The source and the reducible substance should be in contact with each other in order that the reduction might take place. But, from the foregoing experiments, it is clear that hydrogen activated in the ozoniser has a life of its own. It survives even after it leaves the locality where it is activated, though its life is short.

In these circumstances, it is not far from right to suggest that this new hydrogen is an ozone form of hydrogen. No doubt, it is difficult to picture a molecule in which three atoms of hydrogen are in 'Atomic Dance' with the present theories of valency at our back. The author is continuing the work in the laboratory. Hereafter he wishes to study the effect of a polymerising gas such as oxygen on the production of active hydrogen in an ozoniser.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications

- 12651—Bone, S. C.—Purification of saccharic solutions. May 4.
 12629—Carpmael, W.—Manufacture of sulphur dyestuffs. May 4.
 12764—Pedemonte, A. L.—Manufacture of aluminium sulphate and pure ammonia. May 4.
 12726—Roiboul, M.—Manufacture of crucibles for fusing and casting refractory minerals. May 5.

Specifications Published this Week.

- 155,824—Fabriques de Produits Chimiques de Thann & De Mulrose.—Manufacture of anhydrous zinc sulphide.

Abstract Published this Week.

Anthraquinone Derivatives. — Patent No. 176,925.—Mr. D. Segaller, and D. H. Peacock, of British Dyestuffs Corporation, Ltd., Imperial House, Kingsway, have Patented a new process for obtaining oxanthraquinones and their homologues and sulphonic acids.

1-oxanthraquinone-4-sulphonic acid is obtained by heating phthalic anhydride and phenol or phenol-p-sulphonic in sulphuric acid containing boric acid at about 200° C; further heating of the 1-oxanthraquinone-4 sulphonic acid, after isolation or not, in sulphuric acid at 240-250° C. gives quinizarin; the production of quinizarin from phthalic anhydride and phenol may be effected in one operation; catalysts, such as mercury oxide may be added. If phenol-2-4-disulphonic acid is employed or formed, 1-oxanthraquinone-2; 4-disulphonic acid and purpurin are obtained. If phenol is replaced by cresols, the corresponding products are 1-oxy-2-methylan-thraquinone-4-sulphonic acid or 1-oxy-3-methyl-anthraquinone-4-sulphonic acid in the case of O-or m-cresol respectively, the final product in each case being 2-methylquinizarin; p-cresol gives directly 1-oxy-4-methylan-thraquinone.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

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THE OWNERS of British Patent No. 14004 14, entitled: — "Improvements in and relating to Explosives," desire to dispose of the Patent or to enter into working arrangements with a firm likely to be interested.

Particulars may be obtained from Hertford Record Co., Ltd., of Lindsey House, 59, Lincoln's Inn Fields, London, W.C.2. (3242)

WANTED, Nature Nos. 2536 (June 6, 1918), Nature Nos. 2580 (April 10, 1919), Nature Nos. 2594 (July 17, 1919).—Reply, stating price, to "A.S.," Messrs. Puckey & Co., 153, Fleet Street, London, E.C.4. (T.C.)

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3243.

BRITISH COLONIES IN EAST AND WEST AFRICA.

EFFECT OF TAXATION UPON TRADE.

SIR,—I enclose a copy of a letter which has been addressed to-day by the Federation of British Industries to the Secretary of State for the Colonies, calling attention to the serious effect that the high level of taxation in the British East and West African Colonies is having upon trade between the United Kingdom and these possessions.

The burden of taxation is so great that it seriously impairs the purchasing power of the Colonies to the detriment of British export trade; and, at the same time, tends to discourage production on the part of the natives of those raw materials upon which so many industries in this country depend, i.e., cocoa, palm-kernels, copra cotton seed, hides, etc.

The Federation of British Industries, in their letter, suggest the formation in each Colony of local committees, after the nature of the "Geddes" Committee in this country, to examine and make suggestions in regard to reductions in expenditure leading to decreased taxation.

It has been arranged for representatives of the Federation of British Industries to meet the Secretary of State for the Colonies at the Colonial Office, on June 14th, with a view to further discussion on this subject.

Yours faithfully,

SIDNEY ROGERSON,

Directors' Department.

G/1130A.

Ref. 300 J/11.

30/5/22.

SIR,—The attention of the Federation of British Industries has been called to the grave depression of trade in the East and West African Colonies. While much of this depression is no doubt attributable to the general world conditions and consequent falling off in demand for the produce of those Colonies, there appears to be no doubt that this situation, already very difficult, is gravely aggravated by the heavy burden of taxation.

This burden not only directly diminishes the purchasing power of the native population, and consequently restricts the demand

for British goods, but, by removing the stimulus and encouragement to production so necessary in the case of races which have only recently acquired habits of peaceful and steady industry, creates a grave risk of permanently impairing the exporting capacity of the Colonies, upon which both their prosperity and their capacity to absorb British goods ultimately depends.

The primary cause of this taxation appears to be the greatly increased expenditure undertaken both for development and administrative purposes since the war. The Federation fully realises that much of this increase may have been, as in other parts of the world, the inevitable result of post-war conditions, but after a general examination of the facts they cannot escape the conclusion that an unduly optimistic estimate of the revenue-producing capacity of the Colonies concerned was formed during the boom period of 1919-1920, and that this optimism led to the adoption of a scale of expenditure and consequently of taxation possible during such a boom period, but impossible during the present world depression.

They therefore wish to urge most earnestly upon you that immediate steps should be taken to consider carefully all the problems connected with expenditure in these Colonies, with a view to its reduction and a consequent reduction in taxation.

In the first place they would desire to express approval of the step already taken in the Kenya Colony of establishing a Committee including representatives of unofficial commercial interests for the purpose of advising the Government; and especially of the prompt steps which have been taken on the advice of that Committee in order to reduce expenditure and taxation.

They trust that the good work done by this Committee will be continued and extended by the appointment of similar Committees in the other East African Colonies, and they desire to suggest that a somewhat similar course should be pursued in regard to the West African Colonies.

As the local circumstances in the different colonies differ to some extent, as also do the fiscal arrangements in force, they would recommend that a separate local Committee, representative of both official and commercial interests, should be set up in each Colony, which should be empowered to recommend immediate reforms to the Government of the Colony, and also to submit

to the Colonial Office suggestions for further and more far-reaching reforms. A further Committee, also representative of both official and commercial interests, might be set up in this country to advise the Colonial Office upon questions of principle and upon the recommendations forwarded by the local Committees.

The Federation do not desire at the present stage to enter into matters of detail, but they consider that among other points which might well be considered by such a Committee is the desirability of postponing certain general schemes of development which were undertaken under the influence of the optimistic spirit engendered by the boom period, and the possibility of readjusting the financial arrangements made in connection with such developments as are continued, so that a larger proportion of what is in reality a capital expenditure should be met by loan funds, and a smaller proportion from annual revenue.

I am, Sir,

Your obedient servant,

R. T. NUGENT,

Director.

QUATERNIAN SERIES AND ISOTOPES.

TO THE EDITOR OF THE "CHEMICAL NEWS."

SIR,—In the *Chemical News* (1913), 107, p. 247, I gave a quaternian series, comprising elements: H, Be, Cl, Ga; but, at that time, isotopes of the common elements were not known. Furthermore, the atomic weight of beryllium was not very accurately determined. Now that a more accurate determination of the atomic weight of beryllium has been made by Hönigschmid and Birkenbach (*Berichte*, 1922, 55, p. 4), which is 9.018, the series may be reconsidered in the light of this value and of the work of G. P. Thomson (*Phil. Mag.*, 1921, 42, p. 857) on the mass of beryllium from the isotopic point of view. Thomson finds that this element has no isotopes, that is to say, each one of its atoms has a mass of 9. It is now well known that chlorine has isotopes of masses 35 and 37. The atomic weight of gallium is now given as 70.1. The earlier recalculated value was 69.9, so that for the

present purpose it is probable that the value of 70.0 will be near enough to the truth, since there may be isotopes.

The quaternian series may now be constructed out of these newer values so that the secondary differences are in geometrical progression—as in the case of the series beginning with argon, published in this *Journal* July 15, 1921, vol. 123, p. 38—

Element & At. wt.	Differences.	
Hydrogen = 1.0		
	—8	
Beryllium = 9.0		—18
	—26	
Chlorine = 35.0		—9
	35	
Gallium = 70.0		

It is of interest to note that gallium (of Group III.) and beryllium (of Group II.) have masses which seem to violate the general rule of odd and even atomic mass harmonising with odd and even valence, or with odd and even atomic number. I am,
&c.,

F. H. LORING.

THE SALTS OF ZIRCONIUM.

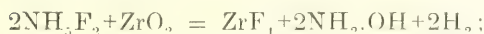
By JOHN MISSENDEN, B.Sc.

The conjunction of bromine with zirconium, as in the case of chlorine, forms two main compounds which are analogous to the chlorides, so that a more detailed description of their peculiarities will be deduced from that heading. *Zirconium bromide*, ZrBr_4 , is a white crystalline powder which, on coming into contact with moisture, forms *zirconium oxybromide*, ZrOBr_2 , a crystalline substance formed of sharp needles. *Zirconium bromide* may be easily converted into vapour at 187°C .

The chlorides form a better-known group. Of these, *zirconium chloride*, ZrCl_4 , is the most common, and may be produced by treating the hot metal with either hydrochloric acid or chlorine. *Zirconium oxychloride*, ZrOCl_2 , is produced with the evolution of heat when moisture is present. According to Weibull, the chloride may be also obtained by passing chlorine gas over a mixture of charcoal and zirconium oxide, ZrO_2 at a temperature of 235°C ., but it is a matter of doubt whether he ever obtained it from the oxychloride. This last compound may also be produced by adding a solution of hydrochloric acid to some zir-

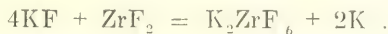
conium hydroxide, $\text{Zr}(\text{OH})_4$. The resulting fluid should be allowed to evaporate, and crystals of the quadro-prismatic order will form. To these, Weibull gave the formula $\text{ZrOCl}_2 \cdot 8\text{H}_2\text{O}$; and, by heating them to 50°C .,* basic oxychlorides may be formed. The hydrated oxychloride crystals may be recognised by having a sharp, sweet taste, and they are soluble in water.

Of the fluorides, *zirconium fluoride*, ZrF_4 , is the most important. It is produced by heating a mixture of hydrogen ammonium fluoride, $\text{NH}_4\text{F} \cdot \text{HF}$, and zirconium oxide, the equation being:

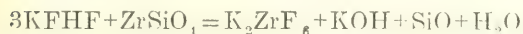


the secondary products being hydroxylamine and hydrogen. After the removal of the former, a little dilute hydrochloric acid may be added, when the zirconium fluoride will combine with the water to produce crystals of the formula $\text{ZrF}_4 \cdot 3\text{H}_2\text{O}$. *Potassium zirconofluoride*, K_2ZrF_6 , may be prepared by a solution of zirconium fluoride being added to a considerable excess of potassium fluoride solution, the action being as follows:

* The writer has found that these crystals yield up 80 per cent. of their water to and at 36°C ., the remainder being driven off gradually until all traces have gone at 57°C .



the remaining potassium uniting with the water. A second way is to fuse hydrogen potassium fluoride and hyacinth together. The equation is:



The zirconofluoride is soluble in water, the ratio of the volumes varying widely with the temperature in accordance with the following table:—

No. of parts		No. of parts	
Temp. C.	water.	Temp. C.	water.
10°	81.75	60°	26.25
20°	64.50	70°	19.75
30°	52.00	80°	14.50
40°	42.25	90°	9.00
50°	34.00	100°	4.25

The salt produced by mixing zirconium fluoride and sodium fluoride, $\text{Na}_2\text{ZrF}_6 \cdot 4\text{NaF}$, betrays the same peculiarities, but is far less soluble.

The carbides take two forms; that having the composition, ZrC , and that having the composition ZrC_2 . The first, *zirconium monocarbide*, is prepared (Moissan) by heating in an electric furnace a carbon tube containing an equal mixture of zirconium oxide and charcoal. It is a fairly hard substance with a greyish-metallic appearance, and burns with a bright flame when heated in air. It is neither decomposed by oxygen nor water at normal temperatures. The second, *zirconium bicarbide*, is prepared in the same manner as the other, but it is necessary to have a considerable excess of charcoal present. This, too, has a metallic lustre, but it will not decompose when treated with water, even at high temperatures.

Zirconium nitrate, $\text{Zr}(\text{NO}_3)_4$, is capable of little investigation. It is produced by evaporating at 85° to 90°C . the liquid formed by mixing nitric acid with zirconium hydroxide; and takes the form of a yellow gelatinous mass.

Hyacinth (zircon), ZrSiO_4 , belongs to the silicate group, and may be regarded as the chief source of zirconium, occurring naturally in granular limestone and crystalline rocks in general (*i.e.*, granite, gneiss, schist and syenite). It takes the form of the quadro-prismatic and quadro-pyramidal orders, and is colourless.

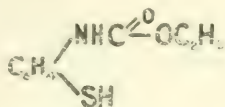
The sulphur group contains only two compounds of any note, a sulphide and a sulphate. The first of these, *zirconium sulphide*, ZrS , is formed when sulphur and zirconium are heated together in association with hydrogen, and it is a dark brown powder. If it is fused with potassium monoxide, potassium monosulphide and zirconium oxide are yielded. *Zirconium sulphate*, $\text{Zr}(\text{SO}_4)_2$, is a white substance which is possessed of the same properties as potassium zirconofluoride. It may be prepared by evaporating to dryness a mixture of sulphuric acid and zirconium hydroxide, and heating the residue to a dull red. The mixture of zirconium sulphate with the hydroxide forms a basic salt with the formula $\text{Zr}(\text{SO}_4)_2 \cdot \text{ZrO}_2$; while if alcohol be added to the normal salt, an insoluble substance, $\text{Zr}(\text{SO}_4)_2 \cdot 2\text{ZrO}_2$, is precipitated.

DEHYDROTHIOTOLUIDIN ITS
ISOMERS, HOMOLOGUES,
ANALOGUES, AND DERIVATIVES.

BY MARTIN MEYER, B.Sc., M.A.
NEW YORK CITY.

(Continued from Last Week).

In this paper he further developed two new methods of synthesis which, however, do not admit of general application, by preparing 2 phenylaminobenzothiazole by heating a mixture of anisyl and thioanisyl mustard oils, synthesized by the method of Mülthäuser¹⁹; and by preparing the oxymethenyl base by distillation of the urethane

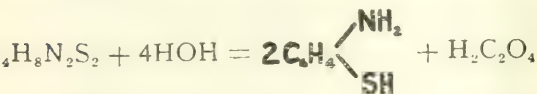


which he obtained from the mercaptan and chlorcarbonic ester. During the same year he conducted a research on naphthylthiazoles and prepared a number by methods similar to those already given. (Listed at the end.)

No very satisfactory proof of the structure of these compounds had appeared at any one time, though taking into consideration all the methods of synthesis which had been developed up to this time, there is little doubt left in the mind of even the most critical reader. In 1887,²⁰ however, Hofmann published a summary of the facts leading to the structural formulæ for the thiazoles, using as a case in point, oxalaminothiophenol. Hofmann's proof of the structure of oxalaminothiophenol may be briefly abstracted as follows:—

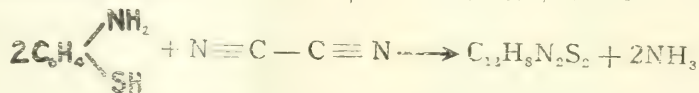
1. Its empiric formula from analysis is $\text{C}_{11}\text{H}_8\text{N}_2\text{S}_2$.

2. On hydrolysis it yields ortho-aminothiophenol and oxalic acid according to the equation:

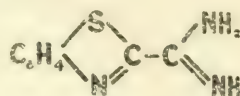


3. It may be synthesized as follows:

(a) By leading cyanogen into a strong solution of orthoaminothiophenol



(b) By adding the mercaptan to an alcoholic solution we obtain amidin as a first product



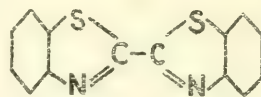
(according to Hofmann) which upon further treatment with the mercaptan yields oxalaminothiophenol. Amidin has two hydrogen atoms which are easily replaced by phenyl groups and must hence be attached to nitrogen atoms, and on treatment with KOH which would hydrolyze amides gives the potassium salt of an acid which upon liberation of the free acid breaks up into methenyl base. The latter may be synthesized from formanilid and sulphur, from thioformanilid by direct oxidation, and by condensation of orthoaminothiophenol with formic acid, all of which in consideration of his previous work, lead to the structure of methenyl base as methenyl base as



The acid must then have been



amidin, as given above, and the original base



4. Now Bladin⁷² working with ortho-nitroanilin had prepared an analogous series of compounds where the sulphur atom is replaced by an imido group, and had assigned a similar structure to his final product, although he arrived at somewhat different ones for the intermediate amidin and acid, and the formula agreed also with the work of Ladenburg (see previously) and others in related fields, so Hofmann believed his formula to be justified.

At the same time he reviewed the work of Jacobson, and contradicted the latter's

statement that he prepared benzothiazole by the oxidation of thioformanilide, al-

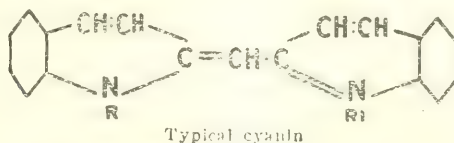
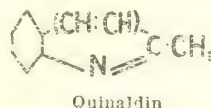
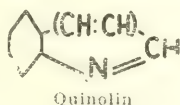
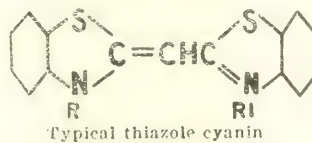
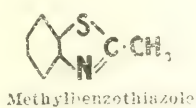
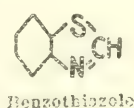
19. Mülthäuser, *Berichte*, 13, 919 (1880).

20. Hofmann, *Berichte*, 20, 2251 (1887).

72. Bladin, *Berichte*, 18, 666 (1885).

though he admitted that the ethenyl base could be obtained in this way.

At the end of this paper he made an interesting series of observations, and described a few preliminary experiments which should be a very fruitful field for research, and yet which it does not appear that he ever followed up, although he promised to do so. There is a marked resemblance between benzothiazole, methyl benzothiazole, quinolin and quinaldin, as can be seen from the formulæ, and it should be possible to obtain from these two a series of dyes resembling the cyanins.



In the cyanines the methyl iodide addition products are used, and he had already noted that the methenyl base did add methyl iodide, as well as amyl iodide. In a preliminary experiment he condensed the two thiazoles, and each with the other quinolin and did obtain reactions with the formation of dyes, but he did not isolate them nor proceed further, nor does it appear that any further work has been done on these compounds.

All of this work, however, had had very little influence on commercial chemistry. Organic sulphur compounds were being manufactured and used as dyes by the Germans, but they were of the phenyl sulphide type described and prepared earlier by Merz and Weith. In February of 1888, A. G. Green,²¹ chemist for Brook, Simpson, and Spiller, an English dye concern, found that by fusing paratoluidin and sulphur he

obtained two substances which were different from the thiotoluidin of the authors just mentioned, one of which was a direct cotton dye, and both of which were primary amines, from which a series of direct cotton dyes could be obtained both by diazotization and coupling, and by substitution. He named these dehydrothiotoluidin and primulin, the latter because it dyed cotton directly a primrose (primula) yellow, and prepared a number of derivatives, the methylated and ethylated bases, sulphonic acids, and several azo dyes, developed a process for producing the azo colour

directly on the fibre using primulin, and noted that the diazonium compound of the latter was affected by light²² to such an extent that it would only couple with the developer satisfactorily under certain carefully regulated conditions. Unfortunately, he neglected to patent his work, and as soon as his firm produced them, and the Germans became interested, they found this out, and of course, did not make this mistake. Dahl and Company immediately patented a process practically identical with Green's (D.R.P. 35790) and all of the important work which followed was covered by German patents.

P. Jacobson²³ took up this topic the following year, and after a brief review of the patent literature, and of the earlier work of Merz and Weith, Krafft, and Truhlar,²⁴ he

21. Green, *Jour. Soc. Chem. Ind.*, 7, 179, (1888).

Green, *Chem. Zeit.*, 1889 (484).

22. Green, Cross, and Bevan, *D. R. P.*, 56,606.

Friedländer, *Fort. d. Th.*, 2, 559.

23. Jacobson, *Berichte*, 22, 330 (1889).

24. Truhlar, *Berichte*, 20, 664 (1887).

developed a better synthesis of dehydrothiotoluidin and primulin from the same starting materials, using a hydrochloric acid extraction, and subsequent crystallization from alcohol as his method of purification. He described dehydrothiotoluidin as crystallizing in colourless needles, M.P. 190° – 191° , and also prepared the phenol, colourless needles from alcohol M.P. 256° , and the acetyl derivative of this, M.P. 132° , crystallizing from alcohol in colourless needles.

During the same year Gatterman²⁵ investigated the reaction, and showed that dehydrothiotoluidin was different from the thiotoluidin of Merz and Weith, although Dahl and Company's original patent described it as such, but his work was not at all enlightening from a structural standpoint. He did make two important contributions, however—he noted that dehydrothiotoluidin formed a dibrom addition product in glacial acetic solution, although he did not isolate the product, and suggested naphthalene as a solvent from which primulin could be crystallized for purification. He also investigated the action of sulphur on the other toluidins.

25. Gatterman, *Berichte*, 22, 122 (1889).

(To be continued.)

TUNGSTEN.

Working of tungsten (problems surrounding the manufacture of pure tungsten were solved to a great extent before the war, but great advances have been made since that date. Casting not possible owing to the high melting point of tungsten; process of working powder into solid metal bars; rolling and cutting the rods into discs; welding discs and rivets.) W. E. John.—*Journal, South African Institution of Engineers, Johannesburg*, Vol. 20, February, 1922, pp. 121-9, 3s. 6d.—(*Bulletin of the Institution of Mining Metallurgy*).

NEW GERMAN BRIQUETTE PROCESS.

A German technical journal records a new process for making hard coal briquettes without the addition of foreign binding material by heating the fine coal to the temperature at which the appearance of the slow combustion gases begins.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, MAY 25, 1922, SIR CHARLES SHERRINGTON, PRESIDENT, IN THE CHAIR.

The following papers were read, the summaries here printed having been supplied by the authors for use at the meeting:—

PROF. C. H. LEES, D.Sc., F.R.S. The Thermal Stresses in Solid and in Hollow Circular Cylinders Concentrically Heated.

The thermal stresses in circular cylinders concentrically heated are calculated by the methods used in a previous communication dealing with spheres. It is shown that the results admit of simple graphical constructions being used for their determination. Two cases of practical importance are worked out—first that of a furnace with the temperature throughout the wall steady; second that of a pillar supporting the floor above a room in which a fire occurs. Curves are given for the thermal stresses produced in each case.

B. F. J. SCHONLAND. On the Scattering of β -Particles. Communicated by Sir Ernest Rutherford, F.R.S.

N. K. ADAM. The Properties and Molecular Structure of Thin Films. Part II.—Condensed Films. Part III.—Expanded Films. Communicated by W. B. Hardy, Sec. R.S.

Studies on films one molecule thick, on water and dilute aqueous solutions, have been extended to many saturated and unsaturated fatty acids of the long straight chain series, and to derivatives, including esters, substituted ureas, an alcohol, amide and nitrite.

In films of every substance studied, below a certain temperature determined by the conditions, the molecules appeared to be closely packed or "condensed." Above this temperature greater areas on the surface were occupied, such films being designated "expanded films."

Two general types of condensed film were found: one in which the hydrocarbon chains are close packed, while in the other probably only the polar groups (of slightly greater cross-section) touch. Values are deduced for the cross-section of a saturated

chain of $-\text{CH}_2-$ groups, and for the polar groups $-\text{CH}_2 \cdot \text{CH}_2 \cdot \text{COOH}$, $-\text{CH} = \text{CH} \sim \text{COOH}$, $-\text{NH} \cdot \text{CO} \cdot \text{NH}_2$, $-\text{CH}_2\text{OH}$, $-\text{CH}_2\text{CN}$, $-\text{COOC}_2\text{H}_5$.

In the temperature interval (about 25°C .) between fully condensed and fully expanded states, pressure-area curves resemble isothermals of a vapour near critical temperature. Probably expanded films resemble vapours in two dimensions. Increase in length of hydrocarbon chains raises temperature of expansion ("vaporisation") regularly. The lateral attraction which tends to keep the molecules close packed therefore depends on length of these chains. There is also evidence that the greater attraction between longer chains diminishes the area of expanded films, just as the ' a/v ' correction of Van der Waals diminishes the volume of a vapour.

The area actually filled by molecules both of saturated and unsaturated acids is probably nearly the same in expanded and in condensed films; therefore it is unlikely that the unsaturated linkage in oleic acid approaches the water closely, as previously thought probable.

ERNEST WILSON. On the Susceptibility of Feebly Magnetic Bodies as Affected by Compression. Communicated by Prof. J. W. Nicholson, F.R.S.

This communication undertakes an investigation of the complex problem which is presented by the effects of mechanical stress upon the susceptibility, retentivity, and other properties of magnetic substances. The present experiments are confined to compressive stress and its effects upon the susceptibility of what may be termed feebly magnetic substances, *e.g.*, rock specimens. It was felt that an investigation into this part of the subject might possibly throw some light upon the susceptibility of the earth's crust, as affected by the enormous mechanical forces with which it has to contend, and their variations.

It is unfortunate that owing to the nature of rock specimens, the compressive stress has been limited to about 1,200 kgm. per sq. cm., but, nevertheless, some interesting results have been obtained, and these are recorded in the present paper. In addition to rock specimens, certain alloys which

may also be described as feebly magnetic, have been tested in order that a contrast may be drawn between rock specimens and metals.

All the specimens are in the form of short bars about 4 cm. in length, whose cross-section is either square, being 1 cm. across each side, or 1 cm. in diameter; and throughout the work the compressive stress has been applied in the direction coinciding with the length of the bar. The susceptibility has been measured (a) in the direction of the stress, and (b) at right-angles thereto.

S. F. GRACE. Free Motion of a Sphere in a Rotating Liquid Parallel to the Axis of Rotation. Communicated by Mr. G. I. Taylor, F.R.S.

The motion is a small disturbance from one of uniform rotation, like a rigid body due to a projection, parallel to the axis of rotation, of a sphere of density equal to that of the liquid and originally at rest relative to it. The method of discussion leads to a perfectly definite mathematical problem, the solution of which has been obtained. The path of the centre of the sphere is a straight line, and the motion is symmetrical about it. The sphere oscillates about a point with amplitudes which diminish rapidly; after one revolution of the liquid the velocity of the sphere is less than 0.02 of its velocity of projection. The velocity of the liquid in this line is oscillatory, the period tending to coincide with that of the sphere's oscillation. The tangential component of velocity at any point on the surface of the sphere tends to become constant in magnitude, but the direction changes. The disturbance over the plane through the centre of the sphere perpendicular to the axis is oscillatory, and confined to the immediate neighbourhood of the sphere. The components of vorticity, however, contain terms proportional to the time, so that the assumptions of small motion are ultimately violated and a physical restriction introduced.

THURSDAY, JUNE 1, 1922, AT 4.30 P.M.

The Croonian Lecture was delivered by Prof. T. H. Morgan, on "The Mechanism of Heredity."

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

The next meeting of the Society will be held on Wednesday, June 7th, at the Chemical Society's Rooms, Burlington House, Piccadilly, W., at 8 p.m.

The following papers will be read:—

"The Action of Natural Waters on Lead," John C. Thresh, M.D., D.Sc., F.I.C.

"The Estimation of Meconic Acid in Opium," H. E. Annett, D.Sc., F.I.C., and M. N. Bose, M.A.

"The Composition of Cows' Milk in the Sudan," A. F. Joseph, D.Sc., F.I.C., and F. J. Martin, M.A., A.I.C.

"The Use of the Daylight Limp in Volumetric and Colorimetric Analysis," W. Singleton.

THE SOCIETY OF GLASS TECHNOLOGY.

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THE CHEMICAL SOCIETY. LECTURE.

At the Ordinary Scientific Meeting, to be held on Thursday, June 8th, 1922, at 8 p.m., in the Lecture Hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1, Dr. H. H. Dale, C.B.E., F.R.S., will deliver his Lecture entitled: "Chemical and Physiological Properties."

THE OPTICAL SOCIETY.

The next meeting of the Society will be held at the Imperial College of Science and Technology, South Kensington, at 7.30 p.m., on Thursday, 8th June, 1922. The following papers will be presented and discussed:—

"Angle comparators of high precision for the goniometry of prisms," by J. Guild, A.R.C.Sc., F.R.A.S., F.Inst.P.

"The changes in aberrations when the object and stop are moved," by T. Smith, F.A., F.Inst.P.

"The classification of optical instruments," by T. Smith, M.A., F.Inst.P.

"Note on achromatism with one glass," by T. Smith, M.A., F.Inst.P., and L. M. Gillman, B.Sc.

"An improved subjective test for astigmatism," by H. S. Ryland.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The Council of the Institution of Electrical Engineers have made the following award of premiums for papers read during the session 1921-22, or accepted for publication:—

The Institution Premium, to Mr. J. G. Hill.

Ayrton Premium, to Mr. L. H. A. Carr.

Duddell Premium, to Mr. T. L. Eekersley.

Fahie Premium, to Mr. E. S. Byng.

John Hopkinson Premium, to Mr. F. P. Whitaker.

Kelvin Premium, to Mr. R. Torikai.

Paris Premium, to Mr. J. A. Kuyser.

Extra Premiums, to Mr. J. Anderson, Mr. F. J. Teago, Mr. W. Wilson.

Wireless Premiums, to Mr. E. B. Moulton, Mr. L. B. Turner, and Mr. C. S. Franklin.

Willans Premium (awarded triennially alternately by the Institution and the Institution of Mechanical Engineers), to Mr. K. Baumann.

GEOLOGICAL SOCIETY OF LONDON.

On May 12th, the President, Prof. A. C. Steward, D.Sc., F.R.S., delivered a lecture entitled "Geological Notes on Western Greenland," of which the following is a brief summary:—

Greenland is a "closed" country; the trade is a monopoly of the Danish Government, and no foreigners or Danes other than Government officials are allowed to go there without special permission. On June 18th, 1921, the lecturer left Copenhagen, accompanied by Mr. R. E. Holttum, of St. John's College, with the primary object of collecting fossil and recent plants on Disco Island and at other localities between lat. 69° N. and 71° N. Godthaab was reached on June 28th, and Godhavn (Disco Island) on July 4th. Rather more than three weeks were passed at the Arctic Station at Godhavn with Mr. Porsild, the Director, who rendered invaluable service. The Arctic Station, which was planned and directed by Mr. Porsild, was afterwards taken over and subsidised by the Danish Government. In the course of two motor-boat excursions a distance of over 600 miles was covered; many localities were visited on the northern and north-eastern coasts of Disco Island, on the coast of Nugsuak Peninsula, also Hare Island, Upernivik Island, Ritenbenk, Sarkak, and Jakobshavn.

Greenland is an island nearly 1,700 miles long, with an average breadth of about 600 miles; approximately a hundred glaciers from the inland ice reach the sea, the largest of which (the Humboldt Glacier) ends in a cliff 60 miles broad. In the course of the lecture attention was called to the various forms of icebergs seen in Greenland waters, and to the views expressed by Mercanton on the origin of the various types. A brief account was given of some of the characteristic types of vegetation. A general account of the physical and geological features of Greenland as a whole was followed by a more detailed description of the Cretaceous and Tertiary sedimentary series of Disco Island and the Nugsuak Peninsula, and of the overlying and protecting basalts which in some places rest directly upon the old Archæan land-surface, to the exclusion of the sedimentary series. Special attention was directed to the nature of the sedimentary rocks (most of which are freshwater in origin), to the occurrence of raised beaches, to evidence of recent sinking of parts of the western coast, and to some of the more

striking examples of dykes and sills in the Cretaceous and Tertiary sedimentary series.

No attempt was made to describe the palæobotanical results; but allusion was made to some of the problems presented by the Cretaceous and Tertiary floras.

The next meeting of the Society will be held on Wednesday, June 14th, 1922, at 5.30 p.m., when the following communications will be read:—

1. "The Petrography of the Cretaceous and Tertiary Outliers of the West of England," by Prof. P. G. H. Boswell, O.B.E., D.Sc., D.I.C., F.G.S.

2. "On some Rugose Corals from the Burindi Series (Lower Carboniferous) of New South Wales," by Prof. W. N. Benson, B.A., D.Sc., F.G.S., and Dr. Stanley Smith, M.A., F.G.S.

THE INSTITUTION OF MINING ENGINEERS.

PRELIMINARY NOTICE OF GENERAL MEETING,
AT SHEFFIELD, ON JUNE 20TH, 21ST, AND
22ND, 1922.

The Seventy-seventh General Meeting of the Institution of Mining Engineers will be held at Sheffield, by invitation of the President and Council of the Midland Institute of Mining, Civil, and Mechanical Engineers, on Tuesday, Wednesday, and Thursday, June 20th, 21st, and 22nd, 1922, at the Cutlers' Hall, by kind permission of the Master Cutler.

INDIA.—JOURNAL OF THE INSTITUTE OF ENGINEERS.

His Majesty's Senior Trade Commissioner in India has sent to the Department of Overseas Trade copies of the first two volumes of the Journal of the Institute of Engineers (India), which have been furnished to him by the Secretary. These volumes show the rapid growth of the new Indian Institution, which has been entrusted with questions affecting the standardisation of materials in India in conjunction with the British Engineering Standards Association in London. The volumes contain papers contributed by engineers in India, on such subjects as the Howrah Bridge, Light Railways in India, Hydro-electric Power, the Manufacture of Portland Cement in India, Water Supply of Bengal Towns, and Electro-chemical Industries, and may be inspected by interested persons on application to the Department (Room 50 A), by quoting the official reference No. 8728/E.D./E.P.).

GENERAL NOTES.

BRITISH TRADE SHIP.

In view of recent announcements of a projected voyage round the world by the steamship "Orontes," renamed "British Trade," confusion has arisen between this voyage and that arranged for another vessel under the auspices of British Trade Ship, Limited, of which Earl Grey is chairman.

The "Orontes," or "British Trade," has no connection whatever with British Trade Ship, Limited, whose proposal is to build a special ship for the purpose of an exhibition and send her round the world in 1924.

The intended voyage of the "Orontes" follows very closely the itinerary sketched out for the British Trade Ship, but Earl Grey and his co-directors of British Trade Ship, Limited, desire to make it quite clear to intending exhibitors on the "Orontes" (or "British Trade") that British Trade Ship, Limited, is in no way responsible for any arrangements in connection with the "Orontes" voyage.

DANGEROUS DRUGS LICENCES.

In the House of Commons last week, Sir J. Baird, Under-Secretary to the Home Office, informed Mr. Hinds that licences under the Dangerous Drugs Act had not been issued to agriculturists, but under an Order of last August, farmers and stock-owners in certain circumstances could obtain a certificate from the Chief Officer of Police which enabled them to obtain tincture of opium for use in the treatment of animals. No fee was chargeable for the certificate.

KEEPING OF POISONS.

Mr. Shortt, the Home Secretary, in reply to Major Barnett, said that he was advised that the regulations for the keeping of poisons directed them to be "kept in a

room or cupboard set apart" for the purpose, and that the observance of this rule should in ordinary circumstances render such occurrences as deaths from strychnine poisoning by misadventure impossible. Enquiries were being made of the Pharmaceutical Society as to the practicability of employing definite and distinctive colours for poisons, and if a favourable report was received, the possibility of making new regulations under the Poisons and Pharmacy Acts would be considered.

BRASS CASTING RESEARCH.

The British Non-Ferrous Metals Research Association, 71, Temple Row, Birmingham, has carried out an extensive research on the influence of gases on high-grade brass. A further investigation is now being started by the Association at the Research Department, Woolwich, in which the support of the Engineering Co-ordinating Board of the Department of Scientific and Industrial Research has been secured.

The advance which has been made in the quality of materials as a result of the increasing demands of the engineer, is not always easy to appreciate, even by those most closely connected with the industry. Well defined specifications and the provision of a greater variety of tests have certainly assisted in these improvements. Brass, both in its cast and worked forms, has shared in full measure in this progress, but the demand is ever for further improvements.

The prime object of the present work is to study the conditions necessary for securing both surface and internal soundness of strip brass ingots, such as are required for cold rolled sheet metal. The investigation will throw much light on other types of casting in non-ferrous alloys, and should interest a wide circle of manufacturers in the metal and engineering trades. Dr. Harold Moore, O.B.E., and Mr. B. B. Genders, B.Met., who have already been engaged successfully on similar work, will have charge of the research, which will be conducted partly in the works of members of the Association and partly in the Woolwich Laboratories.

NOTES ON BOOKS.

Colloid Chemistry of the Proteins, by PROF. DR. WOLFGANG PAULI, translated by P. C. L. THORNE, M.A. (Cantab.), A.I.C. Part I., pp. XI. + 140. London: J. & A. Churchill, 1922. Price 8s. 6d.

Difficultly soluble substances like the metallic sulphides and those bodies of high molecular weight, such as the proteins, lend themselves most readily for transformation into the colloidal condition. Indeed, it is not uncommon for proteins to occur exclusively in this state.

The application of the quantitative methods of physical chemistry to the study of the proteins has been most fruitful, and has enabled Dr. Pauli to advance a consistent theory of the behaviour of these very complex and elusive substances.

This volume includes much recent work and also the results of the author's researches which have not appeared previously. The salts of albumin and of globulin with acids and with alkalis are considered very fully, and special mention must be made of the chapter dealing with the various methods for determining the mobility of protein ions.

Dr. Pauli's original volume was based upon his lecture notes, and this translation should be well received by the English-speaking scientific public. J. G. F. D.

The Analysis of Fuel, Gas, Water and Lubricants, by S. W. PARR. Third Edition. Pp. XII. + 250. New York: McGraw-Hill Book Co., Inc. (London: 6 & 8, Bouverie St., E.C.4), 1922. Price 12s. 6d.

It is frequently difficult to arrange a useful course in Chemistry for Engineering students, which will enable them, later on, to read intelligently and with advantage the applied chemical literature of their main subject.

The present edition of Prof. Parr's valuable book on the analysis of products of importance to engineers has been expanded to admit of its being used by students of chemical, as well as those of mechanical engineering.

Matters of local (Illinois) interest, e.g., fuel supplies, have naturally received especial mention. American methods and

original work are referred to more frequently than are the European, but it is surprising to note that Mabery's name is wrongly spelt on p. 137.

Part I. is based upon the author's lectures and describes the analysis of various fuels, due attention being given to sampling, storage and deterioration; the examination of boiler waters is also described. This subject could be taken early in a course, since it involves a revision of much elementary chemistry. The important but brief chapter devoted to lubricants might be expanded with advantage.

Part II. deals with the details of the laboratory methods, particularly Calorimetry and Gas Analysis (modified Orsat's method). The examination of boiler waters and of oils also receives adequate treatment for such a course.

The book will doubtless appeal to lecturers on this section of applied chemistry, and the fact that it has already reached its third edition indicates that it meets a real need. J. G. F. D.

The Popular Chemical Dictionary, by C. T. KINGZETT, F.I.C., F.C.S. Second Edition. Balliere, Tyndall & Cox, 8, Henrietta St., Covent Garden. Price 21s. net.

The second edition of this well-known book has been enlarged so as to keep pace with the rapidly growing developments in chemistry, and attention has been given to the study of colloids, nitrogen fixation, the flotation processes of ore dressing, radio-activity, refractories, &c.

The author's object has been to produce an encyclopædia of information for the use of professional chemists, merchants, and all who have to deal with chemical manufactured or natural products, and to give in simple language a comprehensive description of each material or subject included. In some cases, as under the heading of colloid, the description runs into several pages and forms a very complete though condensed resumé of the subject. Numerous illustrations are included, as well as a good deal of tabular matter. Some of the illustrations appear to be of rather a rough character, and in some cases unnecessary. For instance, under the heading of Dessicator there is given a picture of a Tait's air pump, which seems rather out of place.

At the end of the book there is a glossary of words used in chemical science under the heading of Addenda, which is a very useful feature of the book.

Practical Plant Biology, a course of Elementary Lectures on the General Morphology and Physiology of Plants, by HILSBY H. DIXON, Sc.D., F.R.S., with 94 illustrations. Longmans, Green and Co., London, 1922. Price 6s.

The book consists of a series of 30 lectures designed as an introductory course in Botany for medical and other science students. Special attention is given in the first lecture to the use and manipulation of the microscope as an aid to biological study, and some very good half-tone photomicrographs are produced.

Each of the following 29 lectures is devoted to a special biological study. Each lecture is followed by a brief course of practical work on the subject of the lecture, thus making the book extremely valuable for individual home study. Biological students generally will welcome the publication of this important series of lectures by a master of such standing as Professor Dixon. We are glad to find that the book ends with a very complete index.

The Principles of the Phase Theory, by DOUGLAS A. CLIBBENS, Ph.D. Pp. XX. + 383. London: Macmillan & Co., Ltd., 1920. Price 25s.

Dr. Clibbens has dedicated his book to Prof. Schreinemakers, and it is interesting to note that the physical chemists of Holland have been conspicuously productive of important results in the particular branch of chemical science dealt with in this volume on the Phase Theory.

A study of its principles has enabled us to understand the conditions of equilibrium of binary and other systems under varying conditions of temperature and concentration. The theory has been fully studied for salts and aqueous solutions in condensed binary and ternary systems, etc.

The graphic mode of representation has been considerably developed in this connection, and it may be emphasised that every point on a diagram has a definite meaning. This is frequently overlooked,

and attention is apt to be confined to the curves only.

The author evidently has a thorough grasp of the principles of the phase theory and heterogeneous equilibria, and his non-mathematical treatment of the subject will be of special service for students, and for whose advantage, presumably, he sometimes repeats himself. J. G. F. D.

THE CHEMICAL, METALLURGICAL, AND MINING SOCIETY OF SOUTH AFRICA.

THE PRESIDENTIAL ADDRESS.

OCTOBER 15, 1921.

By F. WARTENWEILER, A.I.M.M.

It is not uncommon for your President, in his inaugural address, to present a review of recent progress reflecting the current position of that section of the Society's activities in which his own particular interest lies. I have therefore decided to follow, in the main, in the footsteps of this accepted principle. If, at times, I tread on controversial ground, it is for the purpose of inviting full discussion on such subjects as show the trend of recent scientific thought and experience toward radical improvements or changes. I do not altogether decry verbal pyrotechnics and sensation disclosure, as these often have the power of galvanising our members into interest and action.

Basic progress in science is notably slow and by reasoned stages. Many of us, engrossed in our routine tasks and having the responsibility of maintaining the high standard of efficiency set before us, are, perhaps, barely cognisant of the slow development of the art until we pause to consider and review. It is then that evolution is revealed. With these observations I will proceed to illustrate.

UNDERGROUND FEATURES. — In dealing with the Metallurgy of the Witwatersrand it is often taken for granted that the initial steps begin after the ore has been hoisted to the surface and delivered to the reduction department. On some mines this can be accepted as the starting point for the beneficiation of the ore. On others, however, natural chemical processes, which affect the subsequent treatment, begin in the stope, the ore pass and the pump sump, and it is due to the recognition of this fun-

damental fact that one large group has begun ore treatment underground and has extended the responsibility and usefulness of the chemist and metallurgist. I allude to the chemical control of neutralisation of acid mine water by means of lime, the settlement of sludge, its subsequent disposal, and the maintenance of a favourable composition of water for re-use in dust allaying, in which there are pitfalls unseen except by the trained chemist. The precipitation, from a supersaturated mine water, of the calcium sulphate formed in neutralising or its prevention by adequate dilution, cannot be ignored without the payment of the penalty, scale in pipes, or the purchase of an expensive precipitant.

The precise chemical control appeals to the economist and mine owner as a means of saving tons of steel and other corrosive material used underground, not to mention that of cyanide at the surface plant. As an example the experience of one mine may be mentioned where, by careful control, cyanide consumption has been lowered from 0.28 lb. to 0.18 lb. per ton ore treated.

Acidity in mine water has been known to be sufficiently high in some old workings to blister the flesh of men coming in contact with it, as the episode of a mine manager who had such a practical though painful demonstration. We have also heard of miners who have suffered from the burn of strong alkalinity by coming in contact with an accumulation of milk of lime in some back water underground. The one points to the moral of the usefulness of information on the degree of acidity, the other, of wastefulness of lime when not applied under precise control or at the most effective place.

The practice of underground support by means of ore packs is well known, and has been described at our meetings by several members in an interesting manner. In view of the chemical and physical alterations taking place in these packs the question arises whether such a method of mining affects the subsequent extraction of gold, and to what extent. No satisfying answer has been forthcoming, perhaps due to lack of opportunity for a definite test.

Sand filling, which has returned hundreds of thousands of tons of residue sand to the place of origin, the stope, has found its way back to the reduction plants in small quantities, particularly on outcrop mines, where ground movements and consequent break away of sand barricades take

place. The incidence of this acid material in the extraction of gold from the clean current ore is noted by reduction men to be adverse.

CRUSHING AND SORTING, operations so closely related, locally, as to be dealt with under one heading, is such an important and comprehensive subject that it could easily form the sole basis of a paper. Interest seems to have lagged of late years. Is it because the existing plants are considered capable of fulfilling all requirements from the point of view of efficient crushing, sorting, and low cost of operation? Not until you make a close study of various types of stations now in operation are you impressed with the variety of objectives originally affecting the design of each.

The early designers, in the pre-conveyor belt days, built skywards and in conjunction with rotary sorting tables, often employed crushers at the highest point of the structure for cracking large rock prior to sorting. Many of these old plants continue in operation, and excellent work can be obtained. Sorting to the extent of 16 per cent. has been carried out in a station of this type by picking out the valueless class of reef in addition to the usual quartzite and dyke waste.

We then come to the type of station employing conveyor belts, and in which sorting and crushing in two stages is practised. Although the high sorting percentage possible with such a design has fulfilled the most sanguine expectations in this direction, lack of native labour and the economic factors have usually retired it in favour of the simple straight line design now found on our later plants. Such a station with trommel washing or with washing on a sharply inclined portion of the sorting belt lends itself, by reason of simplicity, to minimum capital and running expenditure.

One of the latest plants provides for the washing of all the ore coming from the mine, including the grizzly by-pass, called unsortable fines, which comprise as high a proportion of the ore milled as 40 per cent. This is an innovation and the object is three-fold; first, the avoidance of sending slushy fines to the stamp mill bins, the moisture from which leads to decay of timber and battery foundations, rusts steel, and indirectly causes stem and cam shaft breakage through irregular feed; second, all material passing a $\frac{1}{2}$ -inch punched screen is sent to its most efficient grinding

machine, the tube mill; third, the chemical motive, which allows thorough neutralisation with lime water of that portion of the mine delivery which benefits by such treatment. It is of interest to note that as much as 15 per cent. of the ore milled is by-passed by this method.

With the realisation of the expense of conveyor belt wear and tear, the readoption of preliminary cracking of large rock is being considered in order to reduce incidental rough usage. Also washing trommels stationed at the primary bins are favoured for the elimination of the slushy fines, so that no belt need become a conveyor of a material which, having the property of mobility, is preferably transported by the impulse of a modern centrifugal pump. The sorting percentage becomes a function of the number of native sorters and the amount of waste present. This last depending so often on underground conditions and the reef formation. It is, perhaps, not always realised that many mines, owing to peculiarities in their payable ore channel, present individual problems in sorting which must be studied separately if this important part of ore dressing is to be conducted on an intelligent and scientific basis.

Regarding crushers, which are taken so much for granted, the two standard types, jaw and gyratory, continue to hold the field. That stamping efficiency is greatly advanced by careful maintenance of their wearing parts and by close setting has always been known, and has again reached the practical stage since manganese steel need no longer be devoted solely to armament purposes.

STAMPING.—The Californian stamp and its first cousin, the Nissen, have survived. There are those in our Society who hold the view that these will continue to crush Witwatersrand banket ore at least during our generation. Others feel that improved modern ball or tube mill development will seal their doom as an economical stage crusher. The question is extensive in its bearings, and is most important. Working experiments have recently been conducted on this very point at one of the far East mines. To what extent the crusher and the tube mill can economically encroach on the domain of the stamps, squeezing it out of existence, between their extended functions, is a point for careful trial on an ex-

tended working scale. Let us offer the columns of our *Journal*, as in the past, for the discussion of developments on this subject.

It is on this mining field that the heavy gravity stamp has reached its highest state of perfection. The 1850 pound Californian stamp at the Government Areas mill crushes 28.5 tons per 24 hours through a screen aperture 0.625 of an inch square, while at New Modderfontein the 1,900 pound Nissen stamps 31.5 tons through a somewhat finer screen.

If you are statistically inclined, the size and power of the stamp mills on the Witwatersrand may be illustrated in various ways. For example: if all the 10-stamp batteries were placed adjoining they would make one continuous line extending for a distance of two and a half miles. If all the stamps were combined into one the blow of this mammoth stamp would be equivalent to a weight of 5,200 tons dropping eight inches 99 times per minute.

The roar of stamp mills since the early Californian days has followed the axe of the pioneer in many parts of the world, and whatever may be their ultimate fate, to those of us who have spent many working hours in a stamp mill, the surf-like roar of its many batteries will remain impressed in our minds as symbolical of the restlessness and untiring energy of the gold mining industry.

TUBE MILLING.—Tube milling practice nowadays appears to be rather one of detail. The tube mills are called upon to grind to a finer degree of comminution than ever, one plant delivering a final product of which 90 per cent. passes the 90 linear mesh screen. Good practice now demands a coarse feed, the new installations feeding $\frac{1}{2}$ -inch maximum size. The trials referred to previously experimented with feed as coarse as that fed to stamps.

Scoop discharges of varying effective lift with screen openings of ample size to permit free discharge of the spent pebble are generally adopted except on old plants where the use of small motors does not permit the resulting high power load. Shell liners of the Osborn and El Oro type find general favour. These are keyed and require no holding bolts. End liners are

either cast or forged from discarded stamp mill shoe shanks or dies.

No recent data has been published of the merits of the short 6-ft. dia. by 16-ft. length tube in comparison with the orthodox size, 5-ft. 6-in. dia. by 22-ft. There are also a few 6-ft. dia. by 20-ft. mills in operation whose performances have yet to be compared.

Since the trials of the Giescke ball mill, to my knowledge, no further attempts have been made with steel balls. How effective a modern large diameter ball mill would be on the banket ore leads to interesting speculation. It should be recognised, though, that this ore is one of the hardest and most abrasive known, and a steel ball which readily crushes porphyry ore may prove impotent on banket. There are undoubtedly degrees of hardness and toughness in the ore delivered to reduction plants scattered from Randfontein to Springs, and it may be no idle speculation to look forward to the discovery of an ore that will lend itself to a change in grinding medium.

AMALGAMATION.—Like taxes, the ancient amalgamation recovery method is still with us, and is responsible for from 40 to 70 per cent. of the assay value of our mill feed. While, with our system of classification, preferential amalgamation really takes place in practice, the question arises whether this could not be intensified and mechanical contrivance and concentration called in. The day of the non-amalgamating plant and the extraction of all recoverable gold by cyaniding may arrive. In fact, one mine has committed itself, and elsewhere working trials having this in view have been projected and are only awaiting opportunity and adequate support. Undoubtedly the knowledge that visible coarse gold is found in certain portions of the richer mines has acted as a deterrent with responsible officials. Aside from many technical advantage, the introduction of a method which reduces or eliminates the risk of mercury poisoning would seem to have human merit.

CYANIDING AND CHEMICAL TREATMENT.—No fundamental changes have been effected in cyaniding in the last few years. Considerable experimentation, however, has been conducted quietly, resulting in gains here and there. The practicability of collecting sand and its treatment in the same tank is well established at one of the most recently erected plants. Careful classifica-

tion is a corollary. The importance of close classification and the advantage of fine grinding of the pyritic portion of the ore is receiving constant attention by reduction officials.

Cyanide solution strengths have been on the down grade, and with the adoption of de-aeration of solutions prior to precipitation they will continue on this course. The saving of cyanide and zinc resulting from this constant pressure of experimentation with lower and lower cyanide strengths and with improved precipitation technique has been considerable. On one group of mines alone it has amounted to a quarter million sterling in five years.

Precipitation has received due attention, and on some of the plants a feed rate per diem of 2.3 tons of slime solution per cubic foot of zinc shaving in extractor boxes is current practice. The Chamber of Mines financed extensive trials on the de-aeration of cyanide solution, and, resulting from these, mechanical de-aeration has been decided on at five reduction works, of which three installations are in operation. The expectation of direct and indirect economy promises to be fulfilled. Interesting details, it is hoped, will be brought forward for discussion this year.

Precipitation research has not been lacking within recent years; the margin of possible improvement, however, is small, and any new process calling for a new installation with heavy capital expenditure is severely handicapped by economic considerations.

Oxidising reagents by reason of rapidity of reaction and expense do not find favour these days. Their effect is evanescent and apt to be harmful. The economical and satisfactory supply of oxygen continues to be derived from free air. Experience with de-aeration has taught us how readily air dissolves in solution and how watchful one must be to prevent this at certain stages of the cyanide process.

Vacuum filters are now accepted by the majority as standard slime washing equipment for new plants. Their washing is controllable, depending so much less than the decantation process on ratio of dilution and on the weather. Many installations maintain a consistent daily capacity rate of 3.5 tons dry slime per leaf.

(To be continued.)



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 13466 Catteret, G. Process of producing oxygen compounds of titanium. May 12.
 13057 Ereole, A. Process for manufacture of fertilizers. May 9.
 13567 Hechenbleikner, L. Treatment of acids. May 13.

Specifications Published this Week.

- 154,231 Slatinau, E. Process and apparatus for obtaining reactions between a gas and another substance.
 179,031 Thron, Dr. R. Process for the manufacture of O-alkyl derivatives of hydrocarbons.
 161,539 Farbwerke vorm. Manufacture of a-dialkyl-aminoethyl Baracyl oxybutyric esters.
 179,096 Fairweather, H. G. Method of producing hydrocyanic acid.

Abstract Published this Week.

Synthetic Drugs.—Patent No. 177,283.—Mr. J. Anderson, of Messrs. Boots Pure Drug Co., Ltd., Station St., Nottingham, has obtained a Patent for some new methods of obtaining Synthetic drugs, particularly 3,3'-Diamino-4,4'-dioxycarbenobenzene compounds. A neutral soluble compound of 3,3'-diamino-4,4'-dioxycarbenobenzene base and glucose is prepared by dissolving the base in alkali, adding glucose and well mixing, and finally neutralising with hydrochloric acid. The resulting solution may be employed as such for therapeutic use, or the compound may be isolated by precipitation by alcohol, acetone, etc. The product may also be prepared by warming a suspension of the base in glucose solution, or according to the Provisional Specification, by dissolving the base in hydrochloric acid, mixing with glucose, and then neutralising with caustic soda.

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(3243)

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3244.

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THE CHEMICAL, METALLURGICAL,
AND MINING SOCIETY OF SOUTH
AFRICA.

THE PRESIDENTIAL ADDRESS.

OCTOBER 15, 1921.

By F. WARTENWEILER, A.I.M.M.

(Continued from Last Week.)

SMELTING AND REFINING.—No innovations have been introduced in recent years into refining and smelting on the individual mines. The large Refinery erected near Germiston by the Chamber of Mines for the purpose of refining the gold output of the Witwatersrand by the chlorine process is about to operate, and will no doubt offer a most interesting study to our technical men. We hope to be favoured with a description of its technology in due course.

Acid treatment of the gold-zinc slime from precipitation remains general practice, although with the precipitation improvements referred to this will possibly be discontinued. Subsequent calcination and pot smelting or reverberatory lead smelting is the practice according to preference or works convenience. Small blast furnaces are found useful for smelting by-products on the larger mines. For others the Witwatersrand Co-operative Smelter, a most excellent institution, fills all requirements. The treatment by cyanide of the "black sand" or pyritic by-products from amalgamation has received attention by many of our members, and is well established.

Periodically, schemes for utilising the zinc sulphate liquor, now wasted, are brought forward. Many of them are ingenious and have undoubted merit, and I confidently look forward to an economic utilisation of this liquor.

In concluding the foregoing traverse of local metallurgy, I venture to reiterate that

sound development is visible, and in the words of the young assayer who found a large-looking speck of gold unweighable, is at least equivalent to "two traces."

BASE METALS.—During the present slump in the sale value of base metals these have been neglected in the presence of their gigantic gold neighbour. Our Society has always been interested in the metallurgy of the baser metals, and we have had interesting papers in the past, and look forward to others in the future. Not many miles from here a silver lead smelter was blown in only the other day, that of the Transvaal Silver and Base Metals Co., at Argent. Tin has been smelted for several years at the tin mines situated up-country, and that fascinating branch of metallurgy, that of copper, has been practised at Messina and the Falcon Mine with great activity throughout the war. Great developments are from all accounts taking place at the Congo copper mines in that remote and therefore mysterious region. Rhodesia boasts of a large working chrome iron deposit. Pyrite is being mined in the Lydenburg district, and, after concentration, is sold to chemical plants for both its sulphur and gold content. Considerable asbestos and mica are mined in South Africa, yet the method of selection and preparation for the foreign market, or in other words, the ore dressing, remains a sealed book to most of us.

INDUSTRIAL CHEMISTRY.—During the latter part of the Great War, South African chemical industry received an impetus. Many chemicals were not importable and must of necessity be produced in the country. Artificial chemical fertiliser was among these. Bones suddenly loomed important in the economy of food production as potential carriers of the essential plant foods, phosphate and lime. Kraal ash deposits in the dry Karroo region were sought after for their comparatively low potash content, and bat caves and mineral phosphate deposits were prospected for with the hope of filling the gap in the supply of the necessary phosphates and nitrates. The production of fertiliser is of national importance, particularly applicable to the older districts where the chemical food capital of the soil must not be withdrawn without due replacement. The war-devastated Somme region in Northern France, in appearance not unlike a sweep of the high veld, will again bring forth its wonderful cereal crops

being underlain at grass roots with calcium phosphate. The very mine craters and shell holes have scattered their phosphatic contents over the surrounding soil, replacing that taken away in the form of food.

Some of the fertiliser factories of the Union have survived foreign competition, particularly where low cost raw supplies are available. For the manufacture of superphosphate, phosphate continues to be imported, no lime phosphate having as yet been discovered. Has the Government pushed any reconnaissance or survey in this respect? Has it found it hopeless, and must our wheat production of the future lie at the mercy of imported phosphate? Has the arid coast of the mandated South-West been closely prospected for the life-giving mineral tricalcic phosphate?

In another field of industrial chemistry, between Pretoria and Warmbaths, is situated a truly interesting deposit of carbonate of soda. It is more aptly termed a source, since the soda liquor seeps into boreholes like water into a well. A chemical industry has been developed there, employing crystallisation processes which follow modern lines and are well worthy of study.

Coal of the bituminous class, with which South Africa is plentifully blessed and which is engaging the attention of our captains of industry, is the most wonderful raw chemical substance produced by nature. It can maintain life and civilisation, and, by the known combination of some of its elements into modern explosives and poison gas, can also deprive us of these and force mankind back to barbarism.

At near-by Witbank, an experimental plant on a working scale has been in commission for a short time on waste coal, and is producing a few of the many by-products which start the ball rolling on endless organic subdivisions. The first produced are coke, road tar and creosote, the beginning of an industry of the first importance which, if developed in all its creative ramifications, can render the country, and thereby its people, inestimable service.

The ceramic industry of this district, dealing with the modest art of clay utilisation, is one of magnitude, and produces materials for our furnaces of a quality second to none in the world.

RESEARCH.—Our Society has been noted for the presentation of original papers describing the results of successful construc-

tive researches in pure science. How often negative answers are the reward of long, patient searching in laboratory and works many are too well aware. Such work, although valuable at times in a negative sense, is quietly buried in files.

Research is a tender plant and requires a congenial atmosphere. Inspiration and concentration are its companions. Surroundings, nature of colleagues, past successes, praise, sometimes condemnation, are also forces which circulate its life blood. Research is said to be the occupation of a gentleman. It is a noble calling and should, in theory, be unhampered by financial considerations. The scientist so engaged must have imagination, originality in addition to knowledge, and his mind should be free from all outside worries in order to be receptive of the smallest sign leading to actual discovery. These often hinge on the veriest trifle or on accident. However, if Goodyear, the inventor of rubber vulcanising, had not been engaged in rubber research for years, he would in all probability not have observed the peculiar effect of the heat on a mixture of rubber and sulphur, fallen by accident, on his stove and thus producing the first vulcanised rubber.

Research is often far-reaching in its indirect effect. A member of our Council made public at one of our meetings, as a result of careful research, a short method of determination of oxygen in cyanide solution. This method has supplied a means of obtaining information about our cyanide plant solutions which has proved both instructive and useful.

Perhaps I may be permitted to indulge in a personal reminiscence while on this subject. When engaged in the early days of cyaniding with my chief, on the economic solution of the Homestake cyanide problem, to our dismay the sand charges refused to yield more than fifty per cent. of their gold content. Not until the discovery was made that although well drained most of the extraction was taking place in the top half of the charge, was any progress made. The chief then made one of those correct deductions, characteristic of his well-trained mind, that owing to the presence of a strong oxygen absorbing constituent in the ore the bottom half of the charge suffered under a deficiency of that necessary element, and that to overcome the then prohibitive expense of double treatment oxygen might be supplied by blowing air through the sand from beneath the filter

mat. This proved to be sound and practically spelled success to the cyanide treatment of Homestake tailings. Although apparently a small point, in its result it has been of the utmost practical value.

THE HUMAN ELEMENT.—And, gentlemen, before I close, permit me to speak briefly on the human element, a subject in which our Society has always shown interest and voiced opinions.

To my knowledge, few more elaborate ways and means for partaking in sport and recreation are offered to the employee of industrial concerns anywhere than those which are found on this mining field. With the inception of the 6-day week for reduction workers the nightmare of the 7-day working week has disappeared. As a Society we continue to promote and discuss safety first and health measures, as witnessed by the symposium on prevention of miners' phthisis.

As a class scientists and technical men are inarticulate, and although of no mean mentality and accustomed to the acceptance of responsibility, carry but little power and inject no force into public life. Perhaps studious inclination and political disinclination are at the root of it. It is certainly to our disadvantage in these days when brazen throats and the reiteration of fallacious shibboleths by phrasemongers sway and govern the world. Perhaps we prefer not to mix in the poison gas of public affairs. However that may be, let us hope that our abstinence will never lead to the extinction of what we call our civilisation. It is held by thoughtful men that we have a public duty to perform and a responsibility to accept. As men trained in natural science and disciplined in the hard school of facts, we are expected to possess that conception of duty and love of truth which leads to high ideals. And one of these may well be the stimulation of greater intellectual and creative interest in the every-day life of those performing the routine work of the industries and processes which we have the honour to organise and direct. Our leadership should be an inspiration to those engaged in the wide field of applied science.

We are expected by the country to blaze the trail of scientific and technical progress, not only by transplanting the knowledge and the known processes of technology to these shores, but also to create new methods and to discover fresh resources.

DEHYDROTHIOTOLUIDIN: ITS
ISOMERS, HOMOLOGUES,
ANALOGUES, AND DERIVATIVES.

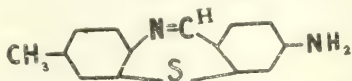
BY MARTIN MEYER, B.Sc., M.A.
NEW YORK CITY.

(Continued from Last Week).

The work of Anschütz and Schultz²⁶ which appeared at the same time, was vastly more important commercially for a great number of patents sprang up from the small space of this paper as a resting place. They studied the action of sulphur on a number of aromatic amines with the following results:—

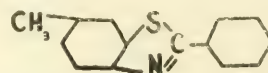
Starting Material	Product	M.P.	Solvent	Form
1. <i>P</i> -toluidin	Dehydrothiotoluidin $C_{11}H_{12}N_2S$	191°	EtOH	Yellow needles
acetyl derivative of	„	225°	EtOH	Yellow prisms
2. Amido <i>m</i> -xylol	Dehydrothioxylidin $C_{16}H_{16}N_2S$	107°	EtOH	Yellow prisms
acetyl derivative of	„	227°	EtOH	White needles
Noted the formation of a dibrom addition product				
3. Amido <i>p</i> -xylol	Dehydrothioxylidin $C_{16}H_{16}N_2S$	144°	EtOH	Yellow needles
acetyl derivative of	„	212°		
Also forms a bromine addition product.				
4. Pseudo-Cumidin {	$C_{18}H_{20}N_2S$	183°	Benzol	Small yellow crystals
	$C_{18}H_{20}N_2S$	125°	EtOH	Yellow needles

Up to this point the structure of the compounds had not been considered except by Green, who assigned to the dehydrothiotoluidin on very little evidence, the structure



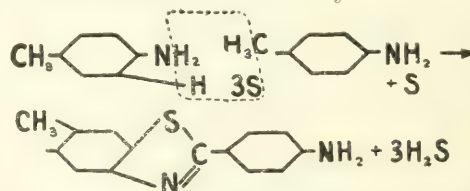
which is not accepted at present. Gatterman and Pfützing²⁷ now took up the prob-

lem. In his previous article just cited, he had prepared



M.P. 123°, by removing the amino group from dehydrothiotoluidin, and he now showed that it was a member of the benzothiazole group and was identical with the product previously prepared by Hess²⁸ from one of the aminothiocresols and benzoyl chloride. To prove this he synthesized it from thiobenzotoluidin by the method of Jacobson, and proved all three products to

be the same. By hydrolysis he then split the two substances and showed that they gave the expected acids and aminothiocresol. From this he concluded that dehydrothiotoluidin was formed by this reaction



26. Anschütz & Schultz, *Berichte*, 22, 580 (1889).

Bayer & Co., *D. R. P.*, 65402; Friedländer, 3, 752.

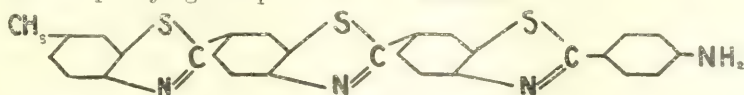
27. Gatterman and Pfützing, *Berichte*, 22,

28. Hess, *Berichte*, 14, 493 (1881).

and had the structure given.

The work on primulin was quite as satisfactory, as it led to two conclusions between which the difficulties of purifying the prim-

ulin prevented them from choosing. It may be considered to be formed from two moles of dehydrothiotoluidin similarly to the latter itself, which would give the formula



or from one mole each of dehydrothiotoluidin and paratoluidin which would indicate it to be:



From 1885 to 1890 a great deal of work was accomplished in the thiazole field; Hantsch and Weber,²⁹ and Möhlar³⁰ and Krohn prepared the methenyl bases, the latter from methyl and dimethyl anilin and sulphur, while several syntheses of the Rosenkörper were accomplished, from benzalanilin, and benzyl anilin by Ziegler³¹ and Wallach.³² Jacobson's original work on the action of oxidizing agents in alkaline solution on the thioanilides has already been mentioned, and he published a number³³

of articles on this reaction by himself and in collaboration with Ney; as well as on the other reaction he had discovered, namely, that of carbon disulphide on oxyazo linkings to produce thiobenzothiazoles, while from 2 thiazole mercaptan by treatment with aniline, Kalkhoff,³⁴ and Jacobson,³⁵ separately, and the latter and Schenke (just given) had made phenylaminobenzothiazole.

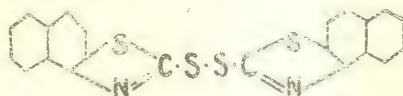
In 1891 Jacobson and Frankenbacher³⁶ prepared several new compounds by treating mustard oils with sulphur.

1.



M.P. 240° small colorless crystals from alcohol.

2.



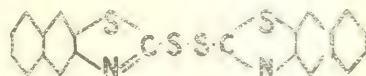
M.P. 194°, crystallizes from benzol and reacts with HgCl_2 in alcoholic solution.

3.



colorless needles from alcohol M.P. 232°.

4.



white needles from CHCl_3 , M.P. 180°

5.



29. Hantsch and Weber, *Berichte*, 20, 3118 (1887).

30. Möhlar and Krohn, *Berichte*, 21, 59 (1888).

31. Ziegler, *Berichte*, 23, 2476 (1890); *D. R. P.*, 51172.

32. Wallach, *Annalen*, 259, 301 (1880).

33. Jacobson, *Berichte*, 20, 1895 (1887).

Jacobson, *Berichte*, 21, 414 (1888).

Jacobson, *Berichte*, 21, 2664 (1888).

Jacobson and Ney, *Berichte*, 22, 904 (1889).

Jacobson and Schenke, *Berichte*, 22, 3232 (1889).

34. Kalkhoff, *Berichte*, 16, 1826 (1883).

35. Jacobson, *Berichte*, 22, 418 (1889).

36. Jacobson and Frankenbacher, *Berichte*, 24, 1402 (1891).

colourless needles from alcohol M.P. 74°.

6. Phenyl-acetamino benzothiazole, colourless needles from alcohol, M.P. 167°.

All are odourless.

Gatterman and Neuberg³⁷ in 1891 worked out a synthesis of dehydrothiitoluidin from thioparanitrobenzotoluid following out the general method of Jacobson, preparing in the course of the procedure 6-methyl-paranitrophenyl-benzthiazole, but did not describe any of its properties. This was more interesting from a theoretical than a practical standpoint, as the synthesis involved a large number of steps, and much material was lost in the course of the reaction.

Research in the field now reached the point where investigation led to the discovery only of new compounds rather than of general reactions for the preparation of the thiazoles. O. Kym³⁸ prepared some of these—6-amino-2-phenyl-benzothiazole, yellow-green leaves, alcohol, M.P. 202°; the acetyl derivative of this compound white needles from alcohol, M.P. 192°-193°; 6-amino-2-para-aminophenyl benzothiazole, yellow needles from alcohol, M.P. 237°-238°; and the diacetyl derivative of this, reddish-needles from alcohol, M.P. 272°-273°. In 1896 Lauth³⁹ prepared oxalaminothiophenol, two dinitro, and diamino derivatives whose structures he did not determine, and a number of azo dyes from the latter, while subsequently other special methods for the preparation of Rosenkörper were developed, among which may be mentioned that of Voswinkel⁴⁰ from benzoyl phenylhydrazine and sulphur, and Wheeler,⁴¹ from orthoamino-thiophenol and benzimido methyl ether, while Schmidt⁴² prepared 6-dimethylamino benzothiazole from dimethyl-paraphenylene-diamine thio-sulphonic acid by condensation with formaldehyde and oxidation of the product with nitrous acid. Reissert⁴³ also did some work on the benzothiazoles, but did not contribute anything new or interesting.

As has already been noted, from a commercial standpoint, the most important compounds of this group are the so-called

37. Gatterman and Neuberg, *Berichte*, 25, 1081 (1892).

38. Kym, *Berichte*, 32, 3502 (1899).

39. Lauth, *Bull. Soc. Chim.*, 15, 82 (1896).

40. Voswinkel, *Berichte*, 35, 1946 (1902).

41. Wheeler, *Am. Chem. Journ.*, 17, 1401 (1895).

42. Schmidt, *Berichte*, 39, 10 (1906).

43. Reissert, *Berichte*, 38, 3433 (1905).

Reissert, *Centralblatt* (1905), 1599.

anhydroses which are obtained by the direct fusion of aromatic amines with sulphur, although perusal of the patent literature shows that almost all of the phenyl benzothiazole amines that have been prepared have also been patented. The basic patents in the dye-field are those founded upon the original work of Green and that of Anschütz and Schultz, and all may be classified according to the particular base with which they deal, into groups as follows:

1. Mono or diamino derivatives of 2-phenyl benzothiazole, or 2-phenyl alpha or beta naphthiazole. These are not very important, and there are comparatively few patents dealing with them.

2. Dehydrothiitoluidin, 6-methyl 2-para-aminophenyl benzothiazole which, as has already been noted, is the most important of all, and a large number of patents deal with its preparation as well as that of its derivatives. The experience of different concerns which have manufactured this base appears to have differed, as may be readily seen from a perusal of the patent literature.⁴⁴ The main difficulty has been the separation of the principal product from the primulin simultaneously formed, a problem which has not been satisfactorily solved although it can be done by a vacuum distillation of the fusion mixture, or by means of the difference in solubility of the ammonium salts of the sulphonic acids of the two bases as described by Noetling⁴⁵ and in the patent just given (the method was discovered by Hall in 1889). For the preparation of some of the thioflavins the sulphonic acids are undesirable, so this method has a serious objection, as up to date it has not been possible to regenerate dehydrothiitoluidin from its ammonium sulphionate.⁴⁶

44. Dahl & Co., *D. R. P.*, 35790; Friedländer, 1, 536.

Kalle & Co., *D. R. P.*, 92011; Friedländer, 4, 824.

Bayer & Co., *D. R. P.*, 65402; Friedländer, 3, 752.

Casella & Co., *D. R. P.*, 53938; Friedländer, 2, 293.

Picke, Lange & Co., *D. R. P.*, 52509; Friedländer, 2, 292.

Höchstes Farbw. Co., *D. R. P.*, 104, 230; *Centralblatt*, 1899 (2) 950.

45. Noetling, *Bull. Soc. Ind. Mulhouse*, 81, 172 (1911).

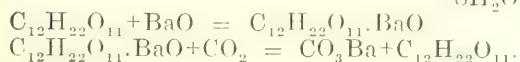
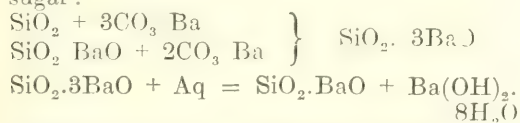
46. Jansen, *Zeit. Farben-Ind.*, 12, 215 (1913).

(To be Continued.)

CHEMICAL NOTICES FROM FOREIGN SOURCES

QUINDOLINES—*E. Grandmougin*.—When primary phenolic amines react in suitable conditions upon indigo, dianylimide-indigos are obtained. The dark blue product obtained with two molecules of aniline corresponds to the formula $C_{28}H_{20}N_4$. It is a feeble base of which, however, diacid salts can be prepared, bluish green in colour and hydrolysed by water. If it is heated with mineral acids in an acetic medium, the bluish green solution turns yellow, and in the solution there is now a new base formed by the isomerisation of the dianilido indigo, and it can be separated from the acid solution by neutralisation. Its formula is also $C_{28}H_{20}N_4$. The yellow salts are darker coloured than the base, and are not hydrolysed by water. From its behaviour, it appears that it is the anilido of a 5-indoquinolinone. It appears that one of the two molecules of aniline furnishes part of the elements for the quindolinic nucleus, and the other part comes from the half skeleton of the indigo. From this it may be deduced that a homologous quindoline would be obtained if a homologous diaryl imido indigo were used, and this conclusion has been verified by experiment.—(*Comptes Rendus*, CLXXIV., 1922, 1175.)

NEW METHOD OF MANUFACTURING BARYTA FOR THE TREATMENT OF MOLASSES—*Camille Deguide and Paul Band*.—The decomposition of barium carbonate for the treatment of molasses presents certain difficulties: At 1,500°, the temperature to which it must be heated, the product melts and attacks the walls of the furnace, and some of the baryta is lost. The authors observed that barium silicate does not show any signs of fusion at the temperature of formation, and it gives a large quantity of hydroxide with water, and they therefore were led to investigate the possibility of using it commercially. They found that the following closed cycle of reactions might be employed in the manufacture of sugar:—



The mother liquors, separated from the barium succrate, can be made to yield the nitrogen and potash derived from the soil, and from 100 kg. of molasses treated, 1 kg. of nitrogen and 6 kg. of K_2O can be obtained.—(*Comptes Rendus*, CLXXIV., 1922, 1175.)

NEUTRAL HOMOCAMPHORIC ETHERS AND THEIR REDUCTION PRODUCTS—*M. Palfray*.—When diethylhomo-camphorate is reduced, it gives the corresponding glycol, a colourless very viscid liquid which very rapidly solidifies and hardens. By the evaporation of an ethereal solution of this glycol crystals fusing at 63-63.5 can be obtained. The diphenylurethane, diacetyl and dibenzoyl derivatives of the glycol have all been prepared, and also the acid and alcohol.—(*Comptes Rendus*, CLXXIV., 1922, 1235.)

BECQUERELITE, A NEW RADIOACTIVE MINERAL—*Alfred Schoep*.—Certain pieces of pitchblende from the mine at Katanga (Belgian Congo) are covered with a yellow crystalline crust, consisting of a mineral which cleaves very readily. The same mineral completely fills the fissures of the pitchblende, and small crystals can be found in the cavities. The microchemical analysis shows the presence of uranium and small quantities of lead. SiO_2 and Fe_2O_3 are also present, but may be regarded as impurities. Analysis shows that the pure mineral is a hydroxide of uranium, the composition of the dried substance being

H_2O	10.78%
UO_3	89.21%

The formula is therefore $\text{UO}_3 \cdot 2\text{H}_2\text{O}$. The radioactivity of this new mineral, for which the author proposes the name becquerelite, is almost the same as that of pitchblende.—(*Comptes Rendus*, CLXXIV., 1922, 1240.)

GRAVIMETRIC DETERMINATION OF ZINC.—*A. Gutbier and K. Staile*.—It is possible to determine zinc gravimetrically as the anhydrous sulphate, and as a control the sulphate can be transformed quantitatively into oxide by heating. The small amounts of SO_4 which remain fixed to the sulphate do not affect the analytical results if the quantities of substance employed amount to 0.1 to 0.2 gr. It is also possible to transform the oxide into sulphide quantitatively.—(*Zeitschr. f. Analyt. Chem.*, 1922, 97.)

PROCEEDINGS AND NOTICES OF SOCIETIES.

ELECTROSYNTHESIS IN ORGANIC CHEMISTRY.

(Abstract.)

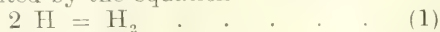
Evening Meeting at the Royal Institution of Great Britain. Friday, April 22, 1922.

Sir James Reid, Bart, G.C.V.O., K.C.B., M.D., LL.D., F.R.C.P., Manager and Vice-President, in the chair.

Sir James Walker, D.Sc., LL.D., F.R.S., Professor of Chemistry, University of Edinburgh.

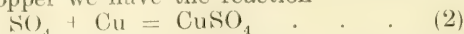
The decomposition of water into oxygen and hydrogen by means of the electric current was effected by Nicholson and Carlisle in 1800, and affords the first example of electrolysis. Davy applied the electrolytic method to the decomposition of many compounds, and finally succeeded in isolating the alkali metals, potassium and sodium, by the electrolysis of fused potash and soda.

Faraday, his successor in the chair of the Royal Institution, laid the foundations of our theoretical knowledge of the subject. He studied in detail the nature and proportions of the products obtained by electrolysis, reduced the manifold experimental data to a simple system, and invented the nomenclature employed at the present day. The process of electrolysis in aqueous solution is conceived by him as follows: When two conducting plates connected with the opposite poles of a battery are immersed in a conducting solution, negative electricity travels towards the positive plate (*positive electrode, anode*), and positive electricity travels towards the negative plate (*negative electrode, cathode*). The electricity does not travel alone, but in association with a material carrier or *ion*, the *anion* or negatively charged ion moving towards the anode, whilst the *cation* or positively charged ion moves towards the cathode. Chemically equivalent quantities of the ions bear equal charges of electricity. When the ions reach the electrodes they are there discharged, and may then act (1) upon each other, (2) upon the water in which they are dissolved, or (3) upon the material of the electrodes. Thus if we electrolyse sulphuric acid H_2SO_4 , which yields the ions 2H^+ and SO_4^{2-} , we have at the negative electrode an action which may be represented by the equation

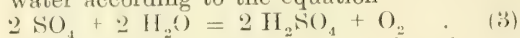


two discharged hydrogen ions combining

with each other to form a molecule of hydrogen gas. If the positive electrode is of copper we have the reaction

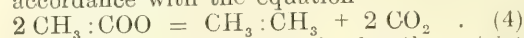


the discharged ion acting on the material of the electrode and forming copper sulphate. If, on the other hand, the positive electrode consists of the resistant metal platinum, the discharged ion acts on the solvent water according to the equation

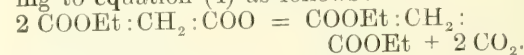


sulphuric acid being regenerated and oxygen gas evolved.

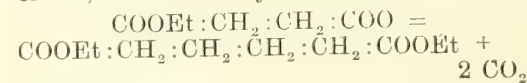
Equation (1) expresses a kind of synthesis, two atoms originally separate uniting to form a single molecule. In organic chemistry synthesis in the strict sense is held to mean the union of carbon atoms originally belonging to separate molecules. The first electrosynthesis was effected in 1849 by Kolbe, who, to take a simple example, electrolysed potassium acetate solution with platinum electrodes, and at the anode obtained the hydrocarbon ethane. The negative ion of the acetates is represented by the formula $\text{CH}_3\text{:COO}^-$, and under appropriate conditions two of these when discharged at the anode interact in accordance with the equation



Here an organic synthesis in the strict sense has been effected, two CH_3 groups originally contained in different molecules being now joined together by their carbon atoms to form a molecule of the hydrocarbon ethane $\text{CH}_3\text{:CH}_3$. This method of synthesis was for long neglected, but attention was again drawn to it in 1890 by a suggestion of Professor Crum Brown, which was worked out in detail in conjunction with the lecturer. If the sodium ethyl salt of a dibasic acid, e.g., malonic acid $\text{COOH}\cdot\text{CH}_2\cdot\text{COOH}$, is electrolysed, the anion $\text{COOEt}\cdot\text{CH}_2\cdot\text{COO}^-$ reacts according to equation (4) as follows:



The product, diethyl succinate, contains two CH_2 groups instead of the single CH_2 group present in malonic acid, and may readily be converted into sodium ethyl succinate, which yields the anion



giving diethyl adipate, which now contains four CH_2 groups. This may be again converted into a sodium ethyl salt, and the process continued.

In this way it was possible to build up, starting from malonic acid, acids containing chains of 2, 4, 8 and 16 CH_2 groups. Starting from acids containing 3, 5 and 7 CH_2 groups, acids were prepared containing 6, 10 and 14 CH_2 groups, and with 6 CH_2 groups the acid with 12 CH_2 groups was prepared. Many acids with branched hydrocarbon chains have also been obtained by the method. In its simple form the electrosynthesis necessarily yields hydrocarbon chains with an even number of carbon atoms, a process of doubling taking place at each stage. However, acids containing an odd number of carbon atoms can be produced by the electrolysis of mixtures. Thus the acid containing 7 CH_2 groups has been prepared by the electrolysis of a mixture of the sodium ethyl salts of acids containing respectively 1 and 6 CH_2 groups, by the interaction of the two different discharged anions.

It is somewhat surprising that the method of electrosynthesis, an outline of which has been indicated, is not more extensively used in practice. Doubtless this is in part due to the care which must be exercised in adjusting the physical conditions in order to secure a successful result. Concentration of solution, temperature, material of electrode, electromotive force and current density at the anode all play an important part in determining the result of the electrolysis. Thus, for example, if we substitute a gold anode for a platinum anode in the electrolysis of a solution of potassium acetate, although the gold electrode is not attacked, and all other conditions remain the same, we obtain at the anode oxygen instead of a mixture of ethane and carbon dioxide. Here synthesis has not been effected: instead of the reaction of equation (4) it is now the action analogous to equation (3) which preponderates.

It is perhaps noteworthy that unlike many of the ordinary synthetic methods of organic chemistry which only succeed in unusual solvents or at comparatively high temperatures, the method of electrosynthesis yields the most successful results in aqueous solution and at the ordinary temperatures, resembling therein the synthetic processes which occur in plants and animals.

[J.W.]

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

ORDINARY MEETING, 7TH JUNE, 1922.

Held at the Chemical Society's Rooms, Burlington House, Mr. P. A. Ellis Richards (President), in the chair.

Certificates were read for the first time in favour of:—

Messrs. George Scott Robertson, D.Sc. (Dun.), F.I.C., Frederick John Martin, M.A. (Cantab.), A.I.C., Frederick Stanley Shadbolt, A.I.C.

Certificates were read for the second time in favour of:—

Messrs. Archibald Steele Whamond, Thomas John Ward.

The following was elected a Member of the Society: Mr. Frederick Major, B.Sc. (Lond.), A.I.C.

The following papers, of which the following are abstracts, were read:—

"The Action of Natural Waters on Lead," by John C. Thresh, M.D., D.Sc., F.I.C.

Following the examination of the action of distilled water on lead (Analyst 1921, 46, 270), the author now gives an account of the action of various salts commonly found dissolved in water, comparing the results with those obtained with moorland waters. He finds that the action produced is not accounted for by the presence of the small quantities of chlorides, sulphates, etc., but is due to an organic acid probably present in peat, and to a silicate, and by the addition of one or both of these the author is able to imitate any natural moorland water.

"The Composition of Cow's Milk in the Sudan," by A. F. Joseph, D.Sc., F.I.C., and F. J. Martin, M.A., A.I.C.

The observations recorded in this paper embody the results of the analyses of samples of cows' milk examined in the Wellcome Tropical Research Laboratories, Khartoum, during the last 10 or 15 years, and the authors find that the Sudan resembles other tropical countries in that the cows' milk is rich both in fat and other solids. They find the total fat production to be approximately the same morning and evening, while there is a distinct seasonal variation in composition.

"The Estimation of Meconic Acid in Opium," by H. E. Annett, D.Sc., F.I.C., and M. N. Bose, M.A.

The authors precipitate the meconic acid as its calcium salt by adding an excess of

calcium chloride solution to an aqueous extract of the opium. They then wash the calcium salt, decompose with dilute hydrochloric acid, and after crystallising the meconic acid, wash, dry, and weigh it. Corrections are applied for meconic acid not precipitated by calcium chloride and for meconic acid dissolved by the hydrochloric acid under conditions used in the experiment.

"The Use of the Daylight Lamp in Volumetric and Colorimetric Analysis," by W. Singleton.

The Daylight lamps used—which are inexpensive—were of the tungsten filament type using daylight glass bulbs. The author described the advantages of the light from the daylight lamp over ordinary artificial light in increasing the efficiency of many chemical indicators. The results obtained in many titrations using indicators in natural daylight, artificial daylight, and ordinary artificial light were given, it being found that the range of colour covered by the end-point with many indicators was shorter and more accurately observed in artificial daylight as in natural daylight. In addition to increasing the accuracy of these titrations, the use of the daylight lamp greatly increased the ease by which this accuracy could be attained.

SOCIETY OF GLASS TECHNOLOGY.

"COLUMNAR STRUCTURE IN SANDSTONE BLOCKS."

(By John Currie, M.A.).

A meeting of the Society of Glass Technology was held in the Chemistry Lecture Theatre, University College, Gower St., London, W.C.1, on Wednesday, May 17th, 1922, at 3 p.m., the President, Prof. W. E. S. Turner, D.Sc., in the chair.

In the absence of the author, the above paper was read by Mr. S. English, M.Sc. In the course of his paper the author said that an interesting example of superinduced prismatic structure had recently been observed in sandstone blocks used in the construction of a glass tank-furnace. The formation was identical in every respect with that which takes place in Nature, particularly in the case of a columnar basalt, and was, in fact, a reproduction of contact metamorphism on a small scale.

The tank in question was used for the manufacture of green bottle glass. The melting compartment measured 19 feet by 15½ feet, and was separated from the rounded working end by a fixed bridge. The dead weight capacity of the tank was approximately 84 tons, when filled to a depth of 3 feet. The construction of the tank was on the ordinary lines, the bottom being of fireclay binders built into a series of six arches. Sandstone blocks formed the lowest course of the sides, and these were surmounted by two courses of fireclay blocks. The fireclay blocks were of the same dimensions, so that the depth of metal in the full tank was 36 inches.

On November 18th, 1921, the tank sprung a leak in the bottom somewhat towards the south side, and about 9 feet from the back wall. The metal drained rapidly through this leak into the cave below, the level in the tank falling from 37 inches to 9 inches in the course of six hours. The gas was kept on all this time, and a full heat of 1,300° C. maintained so as to preserve the fluidity of the metal and allow of its removal both by ladling and by draining through the bottom. However, when the metal level had reached 9 inches, part of the crown collapsed directly above the leak in the bottom, and, to avoid setting fire to the roof of the building, the gas had perforce to be cut off.

The metal falling through the tank bottom into the cave beneath assumed a stalactitic formation, which rapidly solidified and prevented further flow of the metal. But as each successive column was broken away, the flow was renewed, with the result that the level of metal in the tank was lowered from 27 inches to 9 inches in a period of six hours.

After the tank was dismantled, it was observed that the sandstones readily disintegrated into long prismatic columns, many of which were straight, but most of them showing a decided curvature which helped to explain the method of their formation. These prisms were roughly pentagonal in section, and varied in thickness from half-an-inch to an inch and a half. The faces of the prisms were not equally developed, and moreover some of the columns were trigonal, others tetragonal in form. Similar formations were found in Nature, and when this structure was fully developed, as in the well known rocks of Fingal's cave and

Giant's Causeway, the columns tended to assume hexagonal form.

Again many of the columns were incomplete, and tapered off to a point in pyramidal fashion. Also they were intersected at more or less regular intervals by transverse or cross-joints, so that on disintegration the sandstone tended to break up into short columns five or six inches long, some of which were regularly prismatic, others tapering off to a point coincident with the plane of a cross-joint.

This prismatic structure was always developed at right-angles to the planes of cooling. In the space of a few hours the sandstones, which normally were at a temperature not exceeding 800° C., were raised to a temperature of 1,300° C. Expansion took place rapidly, and then the heat was suddenly cut off. The crown of the tank being open, cooling was rapid, and the sandstones underwent sudden contraction, resulting in complete rupture at right angles to the inclined surface of the corroded stones, representing the plane of cooling. Hence the reason for the curved and inclined nature of the columns obtained.

The whole of the evidence went to prove that the formation started at the point of contact with the glass, and that in this instance, as had already been claimed for similar formations in Nature, columnar jointing was distinctly related to the planes of cooling.

Dr. J. W. French has obtained specimens of a similar formation by the rapid cooling of a pot of optical glass. In this instance the sudden contraction caused the rupture to commence near the centre at the surface of the glass, the prismatic formation of the glass extending from that point radially towards the bottom of the pot, and continued in the clay forming the pot itself.

The two cases, although essentially of a different nature, are very similar as to the primary cause and final results, and form an interesting comparison.

Mr. F. W. Adams, M.Sc., followed with a paper entitled, "Some Practical Notes on the Manufacture of White Glass in a Tank Furnace."

During the forenoon, by the courtesy of the directors, a party of members visited the Whitefriars Glass Works of Messrs. J. Powell & Sons (Whitefriars), Ltd., London.

The next meeting of the Society will be held in the Applied Science Department, The University, Sheffield, on Wednesday, June 21st, 1922, at 2.30 p.m.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, THURSDAY,
JUNE 15TH, 1922, AT 8 P.M.

The following paper will be read:—

Ring-chain tautomerism. Part III. The occurrence of tautomerism of the three-carbon (glutaconic) type between a homocyclic compound and its unsaturated open-chain isomeride. C. K. Ingold and E. A. Perren.

THE INSTITUTE OF METALS.

PRESIDENT, LEONARD SUMNER, ESQ.,
O.B.E., M.Sc.

The Annual Meeting of the Institute (the first to be held by the Institute in Wales), will be held at Swansea, on Wednesday, Thursday, and Friday, the 20th, 21st, and 22nd of September.

Members will assemble in Swansea on Tuesday, September 19th, during the afternoon of which day the Honorary Local Secretary's Office will be open for the distribution of Papers and Invitation Cards. On September 20th, at 10 a.m., there will be an Official Welcome by the Mayor, and the remainder of the morning will be devoted to the reading and discussion of papers. After an official Luncheon, a visit will be made to the University College at Singleton, where tea will be provided.

In the evening there will be a reception by the Mayor.

On September 21st the morning will be devoted to the reading and discussion of papers, and after luncheon there will be visits to works, the evening being devoted to entertainment.

Owing to the exceptionally interesting series of papers to be presented, it may be necessary for a morning session to be held on the concluding day of the meeting, Friday, September 22nd, but arrangements will be made for motor excursions in the district, in which there is beautiful coast and inland scenery.

It is desirable to point out that only Members and Student Members will be entitled to participate in the Swansea meeting, and that for the convenience of applicants for membership who are desirous of being elected in time for the meeting, a special ballot is being arranged in connection with which membership application forms should be received by the under-

signed not later than noon on Thursday, July 13th. The ballot will be concluded in time for Members and Student Members so elected to participate in the Swansea meeting. It is hoped that members will be good enough to bring this notification to the knowledge of those who may be desirous of applying for membership of the Institute.

GENERAL NOTES.

ACETIC ACID IMPORTS.

In the House of Commons last week, Mr. George Thorne asked the President of the Board of Trade what proportion of the £42,353 worth of acetic acid imported into this country during the six months ending 31st March last represented grades which had since been deleted from the list of dutiable commodities.

Mr. Baldwin said that the particulars required to be furnished with respect to acetic acid imported during the period specified did not necessarily distinguish between the various grades of the commodity, and he was consequently unable to furnish the information desired.

REPARATION DYES.

Major Mackenzie Wood asked the weight and value of reparation dyes handed over by his department to the Central Importing Agency during the financial year 1921-22; the amount realised for them, and the amount of commission paid to the Central Importing Agency for the sale; what commission the Central Importing Agency charged to purchasers; and whether the President of the Board of Trade was now prepared to put these goods up for competitive tender rather than give the monopoly to one firm?

Mr. Baldwin replied: The quantity of reparation dyes handed over by the Board of Trade to the Central Importing Agency during the financial year 1921-22 was 686 tons, valued at 33,300,000 paper marks. The amount realised during the year 1921-22 from sales was £293,323, and the commission paid to the Central Importing Agency on those sales and in respect of services rendered in connection with dye-

stuffs allocated to the Dominions, was £18,020. A charge is made by the Agency, on sales which they make, of 1 per cent., which is accounted for to the Board of Trade. As regards the last part of the question, I must point out that even if the reparation dyestuffs were sold by tender as suggested by the hon. member, some organisation would be required to carry out the services at present carried out by the Agency.

BRITISH DYESTUFFS CORPORATION.

Mr. Baldwin, in reply to Rear-Admiral Adair, said that the Government directors of the British Dyestuffs Corporation were Lord Ashfield and Sir Henry Birchenough, both of whom had much experience in the direction of large industrial and commercial undertakings.

Rear-Admiral Adair: Does the right hon. gentleman appreciate the fact that, although the nation has £1,750,000 invested in this concern, it has already lost about £125,000?—Mr. Baldwin: I am quite aware of that.

DUTY ON VACUUM FLASKS.

Mr. Charles White asked why laboratory vacuum flasks were liable for duty under the Safeguarding of Industries Act, while ordinary vacuum flasks were exempt as not being scientific appliances or instruments, in view of the fact that many glass articles in the nature of toys were also dutiable.

Mr. Baldwin replied: Laboratory vacuum flasks are included in the list of articles dutiable under the Safeguarding of Industries Act because they fall within the scope of the general heading, "Scientific Glassware," in the Schedule to the Act. Ordinary vacuum flask food containers cannot properly be regarded as included in this or in any other general heading of the Schedule, which is the only question which the Board of Trade have to determine.

The British Non-Ferrous Metals Research Association (Temple Row, Birmingham) has recently carried out an extensive research on the influence of gases on high grade brass. At the Research Laboratory, Wadsworth a further investigation is now being made by the Association with the co-

operation of the Engineering Co-ordinating Board of the Department of Scientific and Industrial Research. The chief object of the present work is to study the conditions necessary for securing both surface and internal soundness of strip brass ingots such as are required for cold rolled sheet metal.

NOTES ON BOOKS.

Food Values, What they are and How to Calculate Them, by MARGARET McKILLOP, M.A., M.B.E., Fellow of King's College for Women, University of London. Second Edition, revised and enlarged. Geo. Routledge & Sons, Ltd., London. New York: E. P. Dutton & Co. 1922. Price 3s. 6d. net.

The first edition of this useful book has met with such appreciation that it has been found advisable to issue a second edition, in which some of the more important subjects treated have been brought up-to-date and new methods are introduced for estimating nutritive requirements of individuals in calories.

The writer acknowledges her indebtedness to an American publication, "Feeding the Family," for tables and other information.

Much has been written recently as to the necessity for introducing the chemist and chemical research into industries generally, and it very naturally follows that the introduction of the chemist into that sphere of life devoted to the preparation of our daily food should be equally necessary.

The author brings the science of chemistry into the kitchen very strikingly, and the valuable information that is introduced into the first few chapters is written in such a manner as not only to be easily grasped but also to form most interesting reading for the intelligent housewife, cook or chef.

The first chapter deals with the elementary chemistry of foodstuffs—sugar, starch, proteins, &c.—and chemical methods for determining their amounts in different samples of foodstuffs. Chapter 2 deals with our need of food, and how that need is satisfied. Comparing food given to a human being with the fuel supplied to a steam engine, the method of heat measurement is very simply and clearly discussed, and the value of the calorie is explained.

This chapter is followed by tables showing the food requirements of men, women, children, &c., measured in calories. A German table is given, showing the units required from the age of 1 year to 60 and over. The amount increases from 28.6 at one year, and appears to reach a maximum between the ages of 25 and 29. From that age to 60 and over, the figures are the same.

Tables are given of a very large number of articles used as food in daily life, with their composition in water, protein, fat, ash, &c., with their heat values in calories per pound. This is followed by a chapter explaining the use of the tables. It is certainly interesting to read the analysis of a meal of stewed steak for four persons in percentages of protein, sugars, fats, &c., in calories to 2 or 3 places of decimals.

The book will be found of great value for cookery classes, and to teachers of domestic economy, but it would be a very good thing if it could find its way into general use in the British home kitchen. The waste of food through ignorance of the science of cookery is too well known to everybody to need pointing out, and we have arrived at a time when it is becoming more and more necessary for everybody to make the best use of the foodstuffs available. We can thoroughly recommend the book, not only to the teacher, but to the general reader.

An Introduction to the Chemistry of Radio-active Substances, by A. S. RUSSELL, M.A., D.Sc. John Murray, Albemarle St., London, W. 1922. Price 6s. net.

The author's aim is to bring the chief facts that are known concerning the chemistry of radio-active substances together in a small compass, so that students who are interested may be able to follow this rapidly developing subject to the present day.

In the preface there is given a list of works from which can be gathered primary sources of information on radio-activity.

The book commences with introducing the minerals containing uranium, and thorium, and a summary of the historical developments of the subject, the disintegration theory, and speculations as to the structure of the atom, isotopes, types of radio-active elements, &c.

This is followed by the analytical chemistry of uranium and thorium. The final chapter is devoted to the discussion of the radio elements as indicators and the extreme sensitiveness of the method is explained. It is stated that a quantity as small as 10^{12} milligrams of Th.B. can be detected by the methods of radio-activity.

The author shows a thorough mastery of the subject, and the book will be found of the greatest use to students in radio-activity.

The Tutorial Chemistry, Part II.: Metals and Physical Chemistry, by G. H. BAILEY, D.Sc. London, Ph.D. Heidelberg. Edited by William Briggs, LL.D., M.A., B.Sc., F.C.S. Fourth Edition. Twelfth Impression. W. B. Clive, London. University Tutorial Press, Ltd., High St., New Oxford St., W.C. Price 7s. 6d. net.

In the present edition new chapters have been introduced on colloidal solutions and adsorption and on atomic numbers. The treatment of the subject of radio-activity has been revised and enlarged, and other minor alterations have been made in the work. The value of the book for tutorial purposes is well known, and the questions enumerated at the end of each chapter are of undoubted value, both to the teacher and the student.

The authors have thought well to remove the chapter on spectrum analysis from the body of the book to make room for one on colloidal solutions. This seems to us to be rather a pity, on account of the growing use of the spectroscope in all analytical work. We should have liked to have seen the chapter on spectroscopy brought more to the front. A table of atomic weights is given at the end of the book, and there is a comprehensive index.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry, by J. W. MELLOR, D.Sc. Vol. I., pp. XV. + 1,065, with 274 diagrams. London: Longmans, Green & Co., 1922. Price £3 3s.

This is the first volume of a work which is to consist of six or more volumes, and aims at giving a complete description of all the compounds known in Inorganic Chemistry. A special attempt is being made to discuss the subject from the point of view of Physical Chemistry.

In the small space available, it is impossible to mention all the subjects dealt with, and even if it were, no useful purpose would be served; suffice it to say that, as this volume is mainly of an introductory character, most of the generalisations, which will be required for application to special cases occurring in subsequent volumes, have been discussed in detail; and, in addition, the chemistry of hydrogen and oxygen and some of their compounds has been dealt with.

Although the author states that the newer work on the structure of atoms and the so-called elements with variable atomic weights will be described in Volume IV., as a sequel to the radioactive elements, it is unfortunate that he should have asked the question (p. 200), "Are Atomic Weights whole numbers?" and answered it in such a way as to leave one with the impression that the atomic weights are best represented by whole numbers. It appears to us that it would have been advisable to have made some reference, at this juncture, to the recent work on "isotopes" which has provided us with such a satisfactory explanation for the values of the atomic weights obtained up to the present, and so removed any possible misunderstanding.

The impression one obtains from a perusal of this volume is that the work, when complete, will be an enlarged edition of the author's well-known "Modern Inorganic Chemistry," and we are delighted to find that as a result of the expansion, the clear, eminently readable style, which characterised the author's previous work, has not suffered in the slightest degree. In anticipation that the work will serve as a standard work of reference, great attention has been paid to the matter of giving the references for the statements made, and apparently with great success. In conclusion we should like to add that, judging from the excellence of this volume, it is probable that this work will prove to be one of the greatest contributions to the literature of chemistry to be made during the present decade.

Dictionnaire Anglais-Français-Allemand de mots et Locutions intéressant la Physique et la Chimie, by R. CORNUBERT, Ingénieur Chimiste, Docteur ès Sciences Physiques. Pages: XXXI. + 297. Paris: Dunod, 47 et 49, Quai des Grands-Augustins, 1922. Price: With paper covers 42 fr., bound 47 fr.

This work, as its title implies, does not claim to be a complete English-French-German dictionary. It is compiled to aid chemists and physicists who require help in the translation of scientific and technical matter not appearing in their own tongue.

Although this dictionary has been compiled by a Frenchman, and so is naturally arranged more especially from the Frenchman's point of view, yet the plan which has been followed enables the Englishman and German to use it to almost equal advantage. This end has been attained by arranging the three languages side by side in parallel columns, whilst, at the same time, a fairly strict alphabetical order has been maintained. Owing to the similarity of many of the words in the three languages, much space has been saved thereby, and the result has been the production of a volume which is convenient for reference.

There is little doubt that owing to the specialised use of words and phrases for the description of physical and chemical phenomena that a dictionary of this kind is required in all scientific and technical libraries, and provided this work is purchased bound, it may be relied upon to render good service.

The Non-Benzenoid Hydrocarbons and their Simple Derivatives, by BENJAMIN T. BROOKS, PH.D. Pp. 612. New York: The Chemical Catalog Company, Inc. 1922. Price \$7.00.

The benzene hydrocarbons have been studied very fully, and in a systematic manner. But whilst a good deal of work has been carried out in connection with the aliphatic and cyclic non-benzenoid hydrocarbons, much remains to be accomplished, and the results so far accumulated still remain unconnected, and their theoretical and practical significance has been largely overlooked.

Doctor Brooks is anxious to stimulate enquiry in this branch of organic chemistry, and as he points out, the higher members of homologous series receive scanty and often inaccurate treatment in textbooks.

The compounds studied include the paraffins, the acyclic unsaturated hydrocarbons, the polymethylenes, and the terpenes and their various derivatives, and related compounds, in so far as these bear upon the subject. In this respect the book goes farther than its title suggests.

As is pointed out, the nomenclature of

spiro- and other bridged ring hydrocarbons is unsatisfactory. Of the systems proposed, that of Prof. Thorpe and his co-researchers is the simplest, and should find general acceptance.

The author has included the latest published results of Russian, German, French and English chemists in widely different fields of enquiry, and his book should appeal strongly to both academic and industrial organic chemists. J.G.F.D.

THE RE-ESTABLISHMENT OF THE GOLD-BASIS OF CURRENCY.

By H. R. SLEEMAN.

This paper is an attempt to stimulate the interest of those concerned in mining, and especially in British gold-mining, in the re-establishment of gold as currency. Producers are concerned with two main factors: the cost of production and the market value of their products. The former is a technical subject, the latter a commercial subject which involves wide economic considerations. With gold producers the latter is at present the more important and the more pressing factor.

The technical aspect has been the subject of close professional study for years. There is no prospect of such immediate improvements therein as will greatly affect the industry's position. The latter has been greatly and adversely affected by the events of late years. A large part of the pre-war market for gold has been eliminated. If the pre-war market can be re-established, the benefit will be far greater than can be achieved by any improvements in working technique than at present appear feasible. To discuss how this can be effected is my object.

It is not suggested that gold should be re-established for the benefit of gold producers. The issue concerns mankind. It is for their benefit that the thing should be done. My point is that the gold producers, being specially and directly concerned, should make it their business to convince the public that it is a benefit, and indicate the way to effect it.

It seems the world's way that, however beneficial certain reforms may be to the community, they are not effected unless those immediately concerned take up the fight. No one else regards them as his own affair.

[Extract from Paper recently submitted to the Institution of Mining and Metallurgy.]



New Patents.

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Latest Patent Applications.

- 13623—Air Reduction Co. Manufacture of alkali cyanides. May 15.
 13835—Casale, L. Catalysts for synthetic of ammonia, etc. May 1.
 14327—Coulbeaux, P. Chemical treatments for refining, etc., metals. May 20.
 14331—Jackson, E. L. Chemical indoor closet. May 20.
 13888—Lisholm, J. H.—Producing a solution of cyanamide from calcium cyanamide. May 17.
 14195—Mackay, H. S. Roasting metallic ores. May 19.

Specifications Published this Week.

- 179201—Dyson, W. H.—Purification of metallic ores and residues containing metallic oxides.
 171962—Rheinisch Nassauische Bergwerks & Hutten Akt Ges.—Process for producing zinc dust having a high percentage of metallic zinc.
 179309—Wade, H. — Manufacture of thorium nitrate.
 168576—Glysyn Corporation.—Manufacture of trichlorhydrin.
 159194—Brat, P.—Recovery of ammonia from peat or the like.
 163685—Chemische Fabrik Weissenstein Ges.—Process for distilling sulphuric acid.

Abstract Published this Week.

Silicates, treating; alkaline sulphates.—Patent No. 177736.—A new treatment of silicates, such as potassium-bearing silicates and clays, in order to recover their constituents in commercially available form has been invented by Mr. E. Levitt, of 323, Grosvenor Avenue, Westmount, Montreal, Canada. The silicate is fused with boric trioxide, or any substance that yields boric trioxide at a high temperature, and the resulting melt suspended in water and treated with sulphur dioxide. Bisulphites of the metals present pass into solution, while silica remains undissolved and is filtered. The filtrate is boiled, whereupon sulphur dioxide is evolved, the bisulphites converted to sulphites, and aluminium precipitated as hydroxide. The precipitate is filtered and the filtrate boiled, with access of air to oxidize sulphites to sulphates. At the same time any iron present is precipitated and filtered. The filtrate then contains sulphates of the alkali metals, if present, and boric acid. The constituents are separated by fractional crystallization, and the boric acid used again.

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THE CHEMICAL NEWS,

VOL. CXXIV., No. 3245

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

ANNUAL CONFERENCE, 1922.

ADDRESS BY THE PRESIDENT (MR. J. PALEY YORKE).

I am conscious at this moment the word Education is one of the most unloved words in the political and social vocabulary. It was never very popular: it was never a favoured child: it was never regarded as a winner of election votes. There have been moments in the course of its life when it has been looked upon enquiringly and even favourably, but they have been rare and of very brief duration. We have been witnesses of the most wonderful of those moments; that moment during the late war when Education was hailed by all and sundry as the very life-blood of national life. That branch of it in which we are particularly interested—Technical Education—was singled out for special praise and declared to be of vital importance for future national development, and—incidentally—for the purpose of winning the war.

We were proud men and women in those days. It was splendid to feel that, at last, the place of education in this nation's life had been recognised universally and openly proclaimed.

To-day we look back upon that brief and transient period and ask ourselves whether it could have happened. If we had to base our answer on the attitude of those whose vision is distorted by the lenses of a false economy and who would impress that vision upon the minds of national and local governments, we should declare roundly that it was impossible to think that Education had been appraised and that proposals had been made for the extension of educational facilities so recently as 1918.

On the other hand if we base our answer upon the general attitude of the individual parent, in every walk of life, we have the greatest difficulty in understanding the position of those responsible bodies who repudiate educational development in the name of the electorate! I think that I am

right in saying that there was never a time in England at any rate—when the individual was so keenly alive to the necessity of education for his child as he is to-day. There was never a time in our history when the average individual made greater sacrifices in order to give his child a better and a longer educational training.

Therefore, there is no need for despair. Terrible as it is to think that knowledge should have been appraised at its highest in those days of war when it was being eagerly sought for the destruction of other lives and the defence of our own, and repudiated in these days of peace when it should be repairing, creating and developing, there is no need for despondency and gloom.

Rather must we gird up our loins and show to the post-war generation of national and local governors what should be the position of Education in the social, industrial, political and moral life of the nation.

It is extremely likely that many worthy people will immediately reply—with some irritation, too—that they know all about the importance of education and all that sort of thing, but that the financial position of the country will not admit of any kind of educational development. They will even declare that retrogression is necessary. That, in fact, is the position of all those who seek for "cuts" in educational expenditure. It is a position comparable to that of a farmer, who having passed through a bad year decided that the only way to secure his future would be to purchase and sow a less quantity of seeds, to expend less labour upon the tilling of the ground, to reduce the quantity of his live stock in order to save the cost of feeding them, and to so reduce his staff of labourers that those remaining could neither cope with the weeds amongst the crops nor gather in the products of the farmstead.

Somehow or other, I do not think that "hard-headed business men" would recommend such a procedure to the farmer. (It may interest hard-headed business men to know that they are the bogey which is always held up to frighten away any proposal for educational development which may involve some expenditure—the idea being that hard-headed business men never authorise expenditure at all!)

Now let me say at once that we know that taxation is high: we know that there is a general and natural desire that it should be reduced as soon as possible and as much

as possible, and we know that there is a general desire for economy in administration. We are parties to these things, and would urge that economy should always be practised because it is only another word for efficiency. Our complaint lies against the misrepresentation of these natural desires and the assumption that the public generally are only anxious to save something on the taxes and rates, and do not care what branch of public service is stripped so long as they share the loot.

All expenditure on public services should be open to criticism, but the criticism should be made in a spirit of understanding. It should be considered whether the service for which expenditure is required is necessary service. If that were agreed, it should then be considered whether the service rendered on account of the expenditure is efficient service or not. If it be efficient service and necessary service, then there is no further discussion. If it be necessary service but inefficiently performed, then immediate steps must be taken to improve its efficiency. If the service be unnecessary, either as a whole or in part, the whole or the part should be abandoned.

I know, of course, that, simple as all this appears, the difficulty lies in deciding what is "necessary service." I submit that the education service could never be regarded as "unnecessary"—though I have some hesitation in putting forward such a sweeping suggestion since I recognise that I have some vested interests in the cause of education.

This Association of Teachers in Technical Institutions is concerned with the interest of what is known as—or, to be more exact, what is called—Technical Education. So sure are we that it is a necessary service, that it is a service upon which industrial development depends, and that it is a service of great educational and social value, that we court enquiry and investigation in every possible way. Particularly do we urge for the appointment of some qualified Committee to enquire into the position of Technical Education in our educational system, to advise whether or not its development should be promoted, and if so to advise what measures are necessary for its promotion in the interests of industries and professions which depend upon the application of science.

A resolution on that matter will be put before the Conference this morning, urging

the necessity for a complete review of the whole field of Technical education, not only in its relation to industry, but to every phase of national life.

In his presidential address last year, Prof. Knox traced the rise and growth of Technical education eloquently and lucidly, and he made out an unanswerable case for its fundamental economic importance to industry.

WHAT IS TECHNICAL EDUCATION?

If I make any special point in this address it would be this—that in addition to its economic importance to industry, Technical education is definitely education, and is as essential, educationally and culturally, as any other branch of educational activity.

There is a tendency on the part of Education Committees and educationists, to stress the adjective, "Technical," and to give to it both a meaning and an emphasis which it should not have. I am convinced from my contact with people interested in education that Technical education is generally misunderstood. Some think that it is something like a glorified kindergarten system. Others think that it is a sort of make-believe education in which the pupils are beguiled into learning a little by playing a lot. Others think of it as a social movement in which by bribes in the form of entertainments, dances and social evenings, a little instruction is unwittingly imbibed. There are others who think that our Polytechnics and Technical Institutions have not advanced one step past the Mechanics' Institutes of 100 years ago. There are others who think that Technical education means the teaching of trades—and are scornful and suspicious in consequence. If it did profess to teach trades I should be amongst the scornful and suspicious. There are others who think that Technical education begins and ends with the making of "soap tidies" and other domestic conveniences.

Finally, in the list of misunderstandings, there are those who hold the idea that Technical education is something which is only for artisans, and that those who have partaken of it are only fitted to be artisans in consequence. This view is serious and deplorable, because it is a view which appears to be held by those who would claim to be counted in the ranks of cultivated people.

This idea and all the other false ideas must be rooted up and the truth planted in their places. It is now 40 years since any national enquiry on technical education was made. The advance of scientific knowledge and the development of the applications of science to industry and manufacture since that time have been tremendous. Technical education has developed, too—for it is the connecting link between science and industry—but it has developed almost furtively and unobtrusively—it has developed beyond the recognition of many of those who imagine themselves to be its guardians. Certainly it is time that enquiry was made in the national interest.

Those of us who seek to advance the cause of Technical education have often heard that we were preaching a gospel of utilitarianism which could not be recognised in any educational scheme. Technical education has been accused of soullessness.

That is somewhat similar to the charge which Goethe levelled at Newton. The poet contended, in effect, that the glory had gone out of the rainbow when Newton showed that white light was composite and might be split, by means of a prism, into the glorious colours of the spectrum. To the scientists the glory and beauty of the rainbow were enhanced and the marvel of it was increased rather than diminished.

Technical Education is essentially scientific education coupled with education in arts and crafts. Your scientist is the least dogmatic of persons: the least cocksure: the first to tell you that he does not understand *why*. Ask him the function of science and he will tell you that it is to *describe and not to explain*. What are his theories but imageries—fantasies, if you like—poems—epics—flights of imagination by which he would describe some phase of nature and conjure up some mental picture that we may marvel at. We protest most strongly against the charge of soullessness. At the same time we do not say that education shall consist only of science and its application. We ask for modern languages, literature, arts and crafts, and contemporary international relations as studies in our Technical Institutions, and we do not admit that what is commonly called a good general education can only be obtained by the study of certain subjects in certain ways, or that education and culture must be associated necessarily with bygone civilisations. Even if it be conceded that a general knowledge of ancient history is necessary, and that an acquaintance with pagan mythology be

deemed desirable, must they be obtained by years and years of toil and weariness from the dead languages?

May I quote the educationists of China? There, the general desire is to acquire what is best in the modern world, but they do consider that the existence of specialists having a knowledge of the classics to be eminently desirable. The function of these specialists is to dig deeply into classic lore and to unearth all things which would seem to be of value historically, artistically, literally and scientifically, and make them known.

THE ESSENTIALS OF A GOOD EDUCATION.

It does not appear to be recognised sufficiently that the sum total of human knowledge is so enormous that no one man can have more than a smattering of most of it. It is almost essential and inevitable that specialisation must be undertaken. Every different trade, profession or occupation represents a form of specialisation, and within any one profession specialisation is essential. It was not always so; but the sum total of human knowledge was not as great as it is now, and was not being added to at the rate at which addition takes place to-day. It must be recognised that as a body the human race must be smatterers, and that each individual must be a smatterer in most things and something of a specialist in one. Were it demanded that each one of us should attain in all things a standard of proficiency represented even by some such standard as the London Matriculation or the School Leaving Examinations, we should never be able to leave school, and nobody would ever pass beyond that standard. That is clearly an impossible position.

I would not urge that every child should start to specialise from his cradle, but I do urge that the time has come when very careful consideration should be given to the question, "What are the essentials for a good general education?" And by a good general education I mean such training and such knowledge that will develop a child's mind and create in him the desire to read and the ability to reason, to enquire, and to understand where understanding is possible; training, too, which will develop his body and bring body and mind into greater unison, and training which will develop his imagination, his courage, and that too rare gift, the gift of being able to marvel at the wonders of "nature" and to appreciate the beauties of life.

(To be continued.)

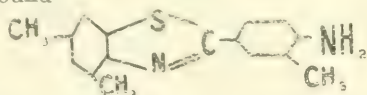
DEHYDROTHIOTOLUIDIN: ITS ISOMERS, HOMOLOGUES, ANALOGUES, AND DERIVATIVES.

BY MARTIN MEYER, B.Sc., M.A.
NEW YORK CITY.

(Continued from Last Week).

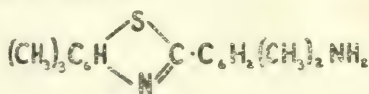
From the practical side the application of the dyestuff is as important as its preparation, and some of the methods of substantive cotton dyeing as applied to primulin are discussed by Haller,⁴⁷ while in the experimental part of this paper an adaptation of the Badische method which works fairly well for laboratory purposes, is given.

3. Dehydrothioxylidins, of which the commercially important one is the meta compound



prepared as mentioned above by Anschütz and Schultz, and described in the Bayer Patent already given.

4. Dehydrothiopseudocumidin, also prepared by Anschütz and Schultz and covered by the Bayer patent, which, however, does not mention which of the two isomers is meant—



5. 6-Para-aminophenyl dehydrothiotoluidin, prepared from benzidine and paratoluidine and the corresponding tolidine compound, covered by several patents which may be found in the third volume of Friedländer.

6. 6-6 Bisdehydrothiotoluidin, prepared also from benzidine and paratoluidin, and the corresponding tolidine compound, which are really further condensation products of those in group 5.

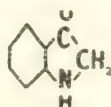
7. Bases of unknown or uncertain structure, such as primulin, the chromins, etc.

47. Haller, *Farber Zeit.*, 25, 301-306, 1914.

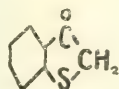
From these seven groups a large number of dyes have been made which fall more or less naturally into sub-divisions: (1) Those bases which are themselves direct colours on cotton, as for example, primulin and chromin; (2) alkylated bases, or alkylated and sulphonated bases such as thioflavins; (3) substituted bases, nitro derivatives, etc., which are comparatively few, although nitro derivatives of dehydrothiotoluidin have been made and used as dyes; (4) oxidation products like naphthamine, yellow produced by the action of bleach on dehydrothiotoluidin, and (5) azo dyes which are by far the greater majority, and can be conveniently sub-divided into monoazo and bisazo compounds, and both of which are represented in larger numbers.

The colours of these dyes are in the main confined to the red-yellow end of the spectrum, although in the derivatives of groups 5 and 6 some blues and greens are found. A series of greens may also be obtained by coupling diazotized dehydrothiotoluidin with the naphthyl-amine sulphonic acids, rediazotizing and treating with dioxy naphthalene disulphonic acids. It is interesting to note in passing that while primulin can be diazotized on the fibre as was shown by Green in his original work, this process is not possible with dehydrothiotoluidin. These dyes are all direct substantive ones for cotton, are reasonably fast to acid, alkali, and bleach, but as has been noted by all the workers in the field, only moderately so to light, a thing which, of course, reduces materially their value.

This fact brings up a rather interesting point in connection with structural relationship of organic compounds. The indigo and thioindigoid dyes are amongst the fastest of all toward light, and owe a great deal of their commercial importance to this fact, as well as, of course, to the wide variety of colours that can be obtained from them, particularly in the case of the latter. There is a rather close genetic relationship between some of the thiazoles and the corresponding compounds in the indigo series as may be seen at a glance from comparison of the accepted structural formulæ:



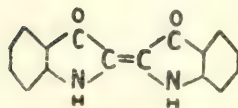
Indoxyl



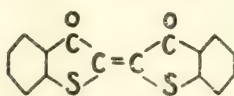
Thioindoxyl
(Thionaphthene)



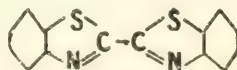
Benzothiazole



Indigo

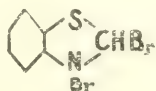


Thioindigo

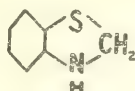


Oxalamido thiofenol

Benzo-thiazole may be regarded as derived from indoxyl by replacement of the carbonyl group with a sulphur atom and removal of the two hydrogen atoms, and oxalamido-thiophenol as bearing a corresponding relationship to indigo. As already mentioned, it has been observed by several workers that the thiazoles from dibrom addition products, and from similar reactions, we should expect the compound which Gatterman did not investigate, to have the formula



and to be reduced to



which would make it resemble indoxyl still more closely, and then reasoning along the same lines, we should still be able to obtain the analogous reduced oxalamido-thiophenol both by reduction of the bromine addition product which has now been made, and by oxidation of the postulated dihydro-methenyl base. If the accepted view of the cause of the color of the indigoid dyes is correct, we should not expect the compound to be a dye.

APPENDIX TO THE HISTORICAL REVIEW.

1. Friedländer devotes a chapter of each volume of his work to patents dealing with sulphur dyes, most of which refer to the so-called anhydro bases, and the large majority of them are descriptive of azo or bis-azo dyes. Among the substances with which dehydrothiitoluidin has been diazotized and coupled may be mentioned by way of example: salicylic acid; beta naphthol; beta naphthol alpha or beta monosulphonic acids; phenols and cresols; itself, primulin, and their sulphonic acids; tetrazodiphenyl or tolyl; naphthionic acid; ammonia; metatolylene diamine; beta naphthylamine sulphonic acids; resorcin; oxynaphthoic acid; naphthol disulphonic acids; dyes such as chrysoidin and Bismark Brown; alpha naphthylamine sulphonic acids; Clève's acids further diazotized and coupled with compounds already given; and the aminonaphthols and their mono and disulphonic acids and ethers.

2. To substantiate the conclusions arrived at regarding the second and third purposes of this research, the following partial list of compounds which have been prepared by previous workers together with their properties, in addition to those already mentioned and others which will be described, is given. These are all benzo-thiazole derivatives and merely the substituting groups and their positions are indicated for the simpler ones.

Groups.	M.P.	Odor	Colour.
benzothiazole	210°	aromatic	none-white
2 chlor	M.P. 24° B.P. 248°	"	"
(?) nitro 2 chlor	192°	none	"
2 hydroxy	139°	"	"
2 ethoxy	25°	aromatic	"
2 acetoxy	60°	none	"
2 amino	129°	"	"
2 phenylamine	159°	"	"
2 methyl	B.P. 238°	aromatic	"
2 ethyl	B.P. 252°	"	"
2 butyl	Not found	not given	"
S2 dibenzothiazole ethane	137°	none	"
p 2 dibenzothiazole benzene	112°	"	"
2 oxymethyl	176°	"	"
2 benzyl		—	"
2 orthohydroxyphenyl	129°	none	"
S-phenyl benzothiazole ethane	111°	"	"
6 methyl	M.P. 15° B.P. 255°	aromatic	"
2, 6 dimethyl	No data		
6 methyl 2 phenyl	125°	none	none
2 phenyl naphthiazole	100-101°	"	"
naphthiazole	45°	"	"
2 methyl naphthiazole	No data		
oxalaminoalphathionaphthol	300°	"	yellow
oxalamino betathionaphthol		"	yellow

(To be Continued.)

DISCRIMINATION BETWEEN CÆSIUM AND RUBIDIUM.

By JOHN MISSENDEN, B.Sc.

The great similarity that the two metals *cæsium* and *rubidium* have for each other, used to present considerable difficulties to past researchers. The usual blowpipe methods and wet reactions are useless, while the semblance of these metals to potassium is evidenced in their general affinities. The only way whereby they may, in their elementary state, be recognised is by careful spectrum analysis, and the spectra projected are so distinctive that the presence of these metals may be detected with perfect certitude for extremely small quantities.

In the spectrum of *cæsium* may be seen two vivid blue lines ($\text{Cs} = 4557$ and $\text{Cs}\beta = 4592$), as well as many others less clearly defined; while *rubidium* produces two lines of the violet order ($\text{Rb} = 4200$ and $\text{Rb}\beta = 4237$), and two other lines of the red order ($\text{Rb}\delta = 7953$ and $\text{Rb}\gamma = 7810$). Considering the latter element, perhaps the two lines Rb and $\text{Rb}\beta$ are the most important for the purpose of discrimination. According to Bunsen, who was the discoverer of these two metals,* the spectrum projection of *rubidium* is so characteristic as to render the detection of the element possible when present to the extent of one five-hundredth of a milligram.

Referring to the comparison of atomic weights, Allen, Bunsen and Johnson fixed their number for *cæsium* at 132.0, but Godeffroy estimated it at 131.6. The actual atomic weight may be said to be above both of these estimations. A careful examination of *cæsium chloride*, CsCl , with a silver salt shows the real atomic weight to be nearer 133, and between this figure and 132.8. Both Bunsen and Grandeau found a number very close to the mean of 84.8 for *rubidium* (the latter obtaining his result from the sulphate), but the generally accepted atomic weight is a trifle higher, i.e., 85.1.

To a certain extent, some discrimination may be effected from the more general properties of the salts. The oxides and hydroxides are so alike as to render the spectrum analysis—paying particular attention to wave-length—the most accurate method of recognition. The two normal sulphates greatly resemble one another; but in the case of *rubidium* the crystals are of the

rhomboid order, while with *cæsium* the crystals are short and prismatic. It is the acid salt which resembles the normal *rubidium* salt. The two formulæ are Cs_2SO_4 and Rb_2SO_4 .

The combination of either of the metals with the halogens produces some interesting compounds well worthy of deeper investigation. In most instances these haloids are very similar, and are perfectly analogous to the corresponding potassium salts. The two compounds, CsCl and RbCl , are simple in construction, but both *cæsium* and *rubidium* unite far more readily with the halogens to produce poly-haloids than does potassium. Of *cæsium* may be mentioned CsI_3 , CsI_5 , CsBr_3 , CsBr_5 , and CsCl_4I (*iodated cæsium tetrachloride*). The *rubidium* poly-haloids are RbI_3 , RbBr_3 , RbCl_2Br (*brominated rubidium dichloride*), RbClBr_2 (*dibrominated rubidium chloride*), RbBr_2I (*dibrominated rubidium iodide*), RbClBrI (*iodo-brominated rubidium chloride*), and RbCl_4I (*iodated rubidium tetrachloride*). The *rubidium* salts, in conjunction with numerous metallic chlorides, also form double salts of the $\text{RbNO}_3 \cdot \text{FeCl}_2$ type.

In the nitrates, an interesting comparison of solubilities forms some distinction between the two metals. Eleven parts of *cæsium nitrate*, CsNO_3 , dissolve in one hundred parts of water at $3.35^\circ \text{C}.$; while *rubidium nitrate*, RbNO_3 , presents a very wide difference, one hundred parts of water dissolving 79.9 parts of the nitrate at the same temperature. Other points on the same curve for the same volume of water are: 20.3 at $0^\circ \text{C}.$ and 442 at $10^\circ \text{C}.$

* Both *cæsium* and *rubidium* had been investigated before by numerous chemists, who mistook their natural compounds for the analogous potassium compounds.

BOOKS RECEIVED.

Modern Microscopy. M. I. CROSS and MARTIN J. COLE. Pages X. + 315. 1922. Fifth Edition. Messrs. Baillière, Tindall, & Cox, 8, Henrietta Street, Covent Garden. Price 10s. 6d.

Dyes Classified by Intermediates. R. NORRIS SHREVE, in collaboration with WARREN N. WATSON and A. R. WILLIS. Pages 631. 1st Edition, 1922. New York: The Chemical Catalog Company, Inc., 1, Madison Avenue. Price 10 dollars.

CHEMICAL NOTICES FROM FOREIGN SOURCES

THE TWO $\alpha\alpha$ - $\beta\beta$ -SUBSTITUTED PROPIOPHENONES AND THEIR DECOMPOSITION PRODUCTS WITH SODIUM AMIDE—*Mlle. Ramart and G. Albesco*.—The authors have prepared the substituted ketones of the type $(C_6H_5)_2CH-CH_2-CO-C_6H_5$ by condensing the mixed organo-magnesium compounds with the benzylidene acetophenones. When these ketones are alkylated with sodium amide they readily split up to give $(C_6H_5)_2CH-CH_2-CONH_2$ and C_6H_6 , and also $(C_6H_5)_2CH-CH_2R$ and $C_6H_5CONH_2$, the two reactions occurring in about equal proportions.—(*Comptes Rendus*, CLXXIV, 1922, 1289.)

AUTO-OXIDATION OF ORGANIC COMPOUNDS—*Marcel Délépine*.—Some years ago the author discovered that many organic compounds containing sulphur are oxidised spontaneously in the air at the ordinary temperature with production of fumes and light. All these compounds contain sulphur linked by a double bond $-S=C-$ or $S=P\equiv$. He now finds that although this auto-oxidation is spontaneous, only a very small quantity of sulphurous vapour is involved, and the reaction stops before any reversible equilibrium can be reached. The presence of fixed alkalis or ammonia enables the oxidation to proceed to its limit. It seems as if the compound containing sulphur were capable of arresting its own oxygenation, but only at a certain limit of concentration, below which the auto-oxidation is possible and spontaneous. Above this concentration which is certainly lower than the saturated vapour tension, the auto-oxidation is indefinitely arrested. It is possible that the process takes place explosively, and if this is the case the phenomenon recalls the phosphorescence of phosphorus.—(*Comptes Rendus*, CLXXIV., 1922, 1291.)

EXTRACTION AND PURIFICATION OF SCANDIUM FROM MADAGASCAR THORVEITITE—*Pierre Urbain and G. Urbain*.—Madagascar thorveitite is easily attacked when fused with soda and the silica contained in it is eliminated when the residue is taken up with water. The insoluble residue is then treated with sulphuric acid, and the solution of sulphates is precipitated with hydrofluoric acid. The fluorides of scandium and the rare earths are washed and then decomposed with sulphuric acid in

excess. The scandium can be precipitated in a very pure state by means of potassium sulphate, after the sulphates have been transformed into nitrates. Ammonia never precipitates all the scandium from liquids containing it, but the precipitation of scandium phosphate is quantitative in an ammoniacal medium, provided that ammonium carbonate is absent. The latter appears to dissolve all scandium precipitates, and the solutions obtained are decomposed by heat, hydroxycarbonates being usually precipitated. The yttric earths containing scandium which have been concentrated in the mother liquors of the precipitates of the double potassium sulphates are transformed by ammonia into hydroxides. These are finally treated with a slight excess of acetylacetone. Only a trace of scandium is found in the mother liquors and the rest of the earths is converted into the crystalline acetylacetonates. When these are treated with chloroform all the scandium is dissolved and a residue of yttric acetylacetonates is left. The final separation is effected by sublimation in vacuo at about 200° , the scandium compound only being volatile.—(*Comptes Rendus*, CLXXIV., 1922, 1310.)

THE SPECTRUM OF RADIUM EMANATION.

By R. E. NYSWANDER, S. C. LIND, AND R. B. MOORE.

(Abstract from the *Astrophysical Journal*.)

Spectrum of RaEm, $\lambda\lambda$ 3982 to 7450.—Two capillary discharge tubes were filled with 0.2 and 1 curie of carefully purified emanation, respectively, and both visual and photographic measurements were made with a 4-prism spectrometer. The relative intensities of the lines differed markedly, as a rule, from the previous observations of Watson and Royds and Rutherford; many strong lines of the 120 previously measured were not found, and yet of the 44 lines obtained, 9 are new lines. Changes of intensity with duration of the discharge were noticed, some lines decreasing, some increasing in strength, while the colour of the discharge changed from a bright glow to violet. λ 5483 and some other lines flashed out on reversing the current after a

thirty-minute run and then quickly disappeared.

Occlusion of RaEm in discharge tube.—After a discharge had passed through the glass capillary tube containing 0.2 curie for 5 hours, 35 per cent. of the emanation had been occluded, most of it in the platinum mirror surrounding the cathode. The other tube became quite hard after a four-hour run.

Modification of Duane's apparatus for purifying RaEm.—The copper wire used to remove oxygen and hydrogen is spirally wound on a silica tube and is heated indirectly by an electrically heated Pt wire passing through the tube, instead of directly by a current through the Cu wire. This arrangement requires less current and less attention.

The spectrum of radium emanation has been determined by Ramsay and Collie;¹ Cameron and Ramsay;² Rutherford and Royds;³ Royds,⁴ and Watson.⁵ The observations of Ramsay and Collie were entirely visual and showed a bright spectrum which rapidly disappeared and was replaced by the secondary spectrum of hydrogen. The first photographs of the emanation spectrum were those of Cameron and Ramsay, whose results showed a strong resemblance to xenon;⁶ hydrogen also made its appearance in the spectrum. Rutherford and Royds photographed the emanation lines with a single (glass) prism spectrograph, using the emanation from 130 mg. of radium. Hydrogen lines were also observed, but to separate these from the emanation lines a side tube attached to the spectrum tube was immersed in liquid air, and at the point of condensation of the emanation its lines disappeared, leaving those due to hydrogen. Royds repeated the work, using a concave grating of a dispersive power, of 16.8 Å per millimeter, and was able to photograph about thirty-five of the more intense lines already obtained by Rutherford and Royds with good agreement and extended the observations far-

ther into the ultra-violet. Watson's investigation was undertaken with a view of accounting for the discrepancies between former observations and his own results; he employed both a prism spectrograph and a grating. His results are in very good agreement with those of Rutherford and Royds.

For the photographic work of the present experiments, a Browning spectrometer with a train of four prisms and photographic attachment was employed, at the University of Denver. The results extended from λ 3982 to λ 7449, being limited in the violet end of the spectrum by the opacity of the glass system. The spectrum of helium was used as a comparison standard. To avoid relative displacement of the two spectra on the plate, a lens was fixed in front of the collimator slit, and the images of the two sources were focused alternately on the slit. By means of a small shutter, adjoining portions of the slit could be illuminated separately. The wave-lengths of the emanation lines were computed by the aid of Hartmann's dispersion formula. The dispersion of the instrument is 13 Å per millimeter at λ 4000, and 136 Å at λ 7000. The total length of the spectrum between these limits is about 6.8 cm. All measurements of wave-lengths were made with a Gaertner comparator of 200 mm. range fitted with a screw of 1 mm. pitch. Individual measurements of a line as read on the comparator seldom differed by as much as 0.005 mm., which will give an estimate of the accuracy of the results. The wave-lengths recorded in the table were determined from six photographs, and where a line appeared on more than one plate the mean value is recorded. The more intense lines were found on each of the six photographs. Two types of dry plates were employed, the Standard Orthonon and the Wratten Panchromatic. In addition to the spectrograph, a Hilger constant-deviation spectrometer was arranged so that visual observations could be made simultaneously with the photographic.

The method of purification of the emanation was developed by Lind, and is a modification of Duane's apparatus. In addition to the process of purification as described in the note, the emanation was frozen down in liquid air for removal of the residual gases by pumping. After purification the gas was collected in small glass vacuum tubes of capillary bore with platinum electrodes sealed in very small bulbs

1 *Proceedings of the Royal Society*, A, 73, 470, 1904.

2 *Ibid.*, 81, 210, 1908.

3 *Philosophical Magazine* (6), 16, 313, 1908.

4 *Ibid.*, 17, 202, 1909.

5 *Proceedings of the Royal Society*, A, 83, 50, 1910.

6 *Ibid.*, A, 82, 22, 1909.

at the ends. Before the liquid air was removed from the vacuum tube in which the emanation was condensed, the tube was sealed off and the photographic exposure was then started as soon as the tube could be adjusted in front of the slit of the spectrograph. The photographs were obtained almost entirely from two spectrum tubes. The first of these contained 208 millicuries of emanation. Two exposures of two and three hours' duration respectively were secured from this tube. It was then broken into small pieces along its length and each piece measured for occluded emanation. The total occlusion in the tube was 35.1 per cent., this being the largest amount of occluded gas measured in any case. This occluded emanation was found to be confined largely to the platinum mirror surrounding the negative electrode. The colour of the tube changed from the characteristic bright glow at the beginning of the exposure to a violet colour after about one hour's excitation. The second vacuum tube contained approximately 1000 millicuries of radium emanation. Four photographs were secured from this tube with almost continuous excitation for nearly four hours, when the tube became quite hard. After the conclusion of our photographic work with this tube, unfortunately it cracked, leaving us without exact measurements of both occlusion and total quantity of emanation. Small, fused, silica, electrodeless, vacuum tubes of capillary size were also tried. They were excited inductively by means of copper coverings deposited electrolytically on platinum coatings on the ends of the tubes. No effect on the photographic plate could be detected after more than one hour's exposure with these tubes.

It was not possible to photograph the entire spectrum on the plate at one exposure. Accordingly the plates were adjusted to receive the violet and red ends of the spectrum alternately. The greater portion of the spectrum appeared on each plate, leaving only the extreme ends to be photographed alternately.

In the table of wave-lengths there have also been recorded, for comparison, along with our results the values determined by Watson and by Rutherford and Royds, since the results of these observers are most trustworthy. Wherever there is coinci-

dence in the lines, the results of the present observations are in excellent agreement with those of the other observers; however, they have recorded many lines which do not appear on our plates. For example, the region between λ 6361 to λ 4732 contains a large number of lines, especially as recorded by Watson, yet our plates show only a few lines in this region and none that could be considered to coincide. It is noteworthy that lines of such great intensity as λ 5582 and λ 5084 should produce no trace on our photographs, nor were these lines observed visually by us.

Among the lines which we observed visually there were several which did not appear on the photographic plates; two of these were broad, faint lines at λ 5058 and λ 4826 respectively, and also a line of low intensity at λ 4735. During the visual observations it was noticed that upon reversal of the current through the induction coil certain lines would appear suddenly and then fade away rapidly. This effect could be produced only after operating the coil as much as 30 minutes in one direction and then reversing the current. The most prominent of these was λ 5483, which appeared very brightly at the moment of reversing the current, but after a few minutes became invisible. It could not be reproduced by later reversals of the current. Other lines appeared brightly at the instant of reversal, but vanished before their wave-lengths could be measured.

Watson has called attention to the differences observed in the intensities of emanation lines; he has also denoted the relative degree of persistence of certain lines in the spectrum. The results of the present experiments have shown that the lines of greatest intensity are the most persistent, and that the intensities of these strong lines change very little on successive plates obtained from the same tube. The group of faint lines between λ 4463 and λ 4492 with one exception were recorded only on the first plate of one tube. On the other hand, there are a number of lines which seem to develop as the time of excitation of the tube advances. For example, the line λ 4721.2 has an intensity of 1 on the first plate, 4 on the second plate, and 5 on the third plate. The line λ 4625.3 does not appear in the first exposure of either tube,

but appears on the second and third plates with increasing intensity. The line λ 4341.0 also belongs to this class. The lines λ 4577, λ 4169, and λ 4307, which Watson has observed to be fugitive lines, for us are quite persistent.

The emanation for these experiments was derived from a supply of radium belonging to the United States Bureau of Mines' Experimental Station at Golden, Colorado.

PROCEEDINGS AND NOTICES OF SOCIETIES.

ROYAL SOCIETY.

LIST OF PAPERS READ JUNE 22, 1922.

G. I. Taylor, F.R.S.: The Motion of a Sphere in a Rotating Liquid.

Prof. T. R. Merton, F.R.S., and D. N. Harrison: On Errors arising in the Measurement of Unsymmetrical Spectrum Lines.

E. F. Armstrong, D.Sc., F.R.S., and T. P. Hilditch, D.Sc.: A Study of Catalytic Actions at Solid Surfaces. Part VIII.: The Action of Sodium Carbonate in promoting the Hydrogenation of Phenol. Part IX.: The Action of Copper in Promoting the Activity of Nickel Catalyst.

E. A. Milne: Radiative Equilibrium: The Relation between the Spectral Energy Curve of a Star and the Law of Darkening of the Disc towards the Limb, with special Reference to the Effects of Scattering and the Solar Spectrum. Communicated by Prof. H. F. Newall, F.R.S.

C. W. Hinshelwood: On the Structure and Chemical Activity of Copper Films and the Colour Changes accompanying their Oxidation. Communicated by Prof. J. W. Nicholson, F.R.S.

R. C. Ray: Heat of Crystallisation of Quartz. Communicated by Dr. M. W. Travers, F.R.S.

ORDINARY MEETING—JUNE 1, 1922.

Sir Charles Sherrington, President, in the Chair.

The Croonian Lecture was delivered by Prof. T. H. Morgan, Columbia University, on "The Mechanism of Heredity"; the summary here printed having been supplied by the Lecturer for use at the meeting:—

The changes that take place when the germ-cells ripen are known to be of such a

kind that, granting the hereditary elements are carried by the chromosomes, these changes may be made to serve as a mechanism that furnishes an explanation of the principles of heredity discovered by Mendel.

If the criticism be made that these facts only show a parallelism between the chromosomes and inheritance of characters, then the following evidence bears very directly on the issue.

In the course of the ripening of the germ-cells irregularities occur at times in the distribution of the chromosomes. These irregularities can be followed in successive generations, and the departures from the ordinary course of inheritance, that are there shown, are found to be *exactly* related to the new distributions of the chromosomes. Without a detailed account of this evidence it is not possible to do more than to state that the facts furnish most convincing testimony that the Mendelian characters are carried by the chromosomes.

Not only is there evidence that the chromosomes are the bearers of the hereditary elements, but owing to a phenomenon known as "crossing-over" it is possible to determine that the hereditary elements lie in a single line in each chromosome. It is even possible to form a rough estimate of the upper limits of size of these elements, although at the present time such estimates are necessarily very crude, and are interesting only as the first attempt to determine the size of the "gene."

THURSDAY, JUNE 15, 1922, AT 4.30 P.M.

Papers read:—

H. M. Evans, M.D.: The Defensive Spines of Fishes, Living and Fossil, and the Glandular Construction in connection therewith, and Observations on the Nature of Fish Venoms. Communicated by Dr. H. H. Dale, F.R.S.

D. W. Cutler, L. M. Crump, and H. Sandon: A Quantitative Investigation of the Bacterial and Protozoan Population of the Soil: with an Account of the Protozoan Fauna. Communicated by Dr. E. J. Russell, F.R.S.

D. W. Devanzen: The Development of the Calcareous Parts of the Lantern of Aristotle in *Echinus miliaris*. Communicated by Prof. E. W. MacBride, F.R.S.

A. Lipschütz, M.D., C. Wagner, R. Tamm, and F. Bornmann: Further Experimental Investigations on the Hypertrophy of the Sexual Glands. Communicated by Dr. F. R. A. Marshall, F.R.S.

ROYAL INSTITUTION.

A General Meeting of the members of the Royal Institution was held on the 12th June, Sir James Crichton-Browne, Treasurer and Vice-President, in the chair. Mr. H. Cooke, Mr. E. Davies, Miss Joan Evans and Mrs. A. Jacobs-Larkecom, were elected members. The Chairman reported the death of Ernest Solvay, an Honorary Member of the Institution, and a resolution of condolence with the relatives was passed.

THE OPTICAL SOCIETY.

At a meeting of the Optical Society, held on Thursday, 8th June, Sir Frank Dyson, F.R.S., President, in the chair, the following papers were read and discussed:—

"Angle Comparators of High Precision for the Goniometry of Prisms," by J. Guild, A.R.C.Sc., F.Inst.P., F.R.A.S.

This paper describes applications of the method of substitution to goniometric measurements of high precision. A simple arrangement is described with which measurements accurate to within one or two seconds can readily be made, and a more elaborate arrangement with which an accuracy of about 0.1 second may be attained. The latter embodies a method which appears to be new, of obtaining very minute variations in the direction of a beam of light emerging from a collimator by placing near the focal plane of the latter a "variable prism" of simple design and construction.

"The Changes in Aberrations when the Object and Stop are moved," by T. Smith, M.A., F.Inst.P.

If the aberrations of any centred optical system are known both for an object which intersects all rays transmitted by the system and also for the centre of the effective stop, the position in the image space of the emergent portion of a given incident ray is known, and the aberrations in the image of any other object for any stop position can be expressed in terms of those for the first object. The investigation aims to express the relations in the second case in terms of those present in the first when the objects are planes normal to the axis of symmetry whatever the order of the aberration may be.

"The Classification of Optical Instruments," by T. Smith, M.A., F.Inst.P.

Exception is taken to the classification of optical instruments by the signs of their

powers, and an alternative division comprising five classes is proposed, based upon the separation of the four Gaussian constants into two groups according to their signs. This classification cannot be modified by the addition to the system of inverting prisms and the like, and the properties usually associated with the sign of the lens in reality depend upon its class according to the new system. Each class may have systems of positive or of negative power.

"Note on Achromatism with one Glass," by T. Smith, M.A., F.Inst.P., and L. M. Gillman, B.Sc.

Systems composed of thin lenses of the same kind of glass and achromatised by selecting suitable positions for the components are members of the class (AD) (BC), so that if the object is real the image is virtual. Apochromatic systems constructed from normal achromatic lenses belong to the same class. The outstanding aberrations for systems constructed of a single glass but belonging to other classes are of considerable magnitude.

"An improved Subjective Test for Astigmatism," by Herbert S. Ryland.

The present test has been designed to obviate certain difficulties which patients experience when the usual test card is used. It consists of an opaque disc perforated along two diameters at right angles with a series of square apertures. These apertures and the distances between them subtend angles of 1' at the usual testing distance. The plate is illuminated by diffused light from the rear.

ROYAL MICROSCOPICAL SOCIETY,
20, HANOVER SQUARE, LONDON, W.1.

A meeting of the Society was held in the Lecture Hall at the above address on Wednesday, 21st June, 1922, at 7.30 for 8 p.m., when the following papers were read:—

Mr. A. Chaston Chapman, F.I.C., F.R.S., F.R.M.S. "The Use of the Microscope in the Brewing Industry."

Mr. A. Brooker Klugh. "The Plunger-Pipette."

Mr. E. A. Spaul, B.Sc. "The Gametogenesis of *Nepa cinerea* (Water Scorpion)."

Mr. James Strachan, F.Inst.P., F.R.M.S. "The Microscope in Paper Making."

The names of the following gentlemen will be submitted to the ballot for election as Ordinary Fellows of the Society: Mr. J

Nelson Arnold, F.P.C., M.S.P., Mr. Godfrey Hecht, Mr. James W. Low, B.Sc.

The Annual Conversazione of the Society will be held at the Examination Hall, 8, Queen Square, Bloomsbury, W.C.1, on Wednesday, 11th October, 1922, from 7.30 to 10.30 p.m. Offers of assistance from Fellows of the Society who can bring exhibits will be greatly appreciated by the Hon. Secretaries.

THE INSTITUTE OF PHYSICS.

LECTURES ON "PHYSICS IN INDUSTRY."

No. II.: "Physics in Engineering Practice," by Sir James Alfred Ewing, F.R.S.

Members of the Faraday Society are invited to attend the above lecture, which will be given on Tuesday, July 4th, 1922, at 5.30 p.m., in the Hall of the Institution of Electrical Engineers, Victoria Embankment, W.C.2.

Sir Charles Parsons, K.C.B., F.R.S., has kindly consented to preside.

THE FARADAY SOCIETY.

June 12th, 1922.

DATES OF ORDINARY MEETINGS OF THE SOCIETY.

The Council has decided that in future the Ordinary Meetings of the Society shall be held on fixed dates. There will always be Ordinary Meetings on the third Monday in February, May, October and December. General discussions and additional meetings may be held on other dates, but so far as possible the third Monday will always be chosen.

PUBLICATION OF TRANSACTIONS.

In future the transactions will be published four times annually, and will appear on the 1st of February, May, October, and December.

It is hoped that the holding of regular Ordinary Meetings and the more regular publication of the transactions will be helpful to members who desire to present original communications to the Society. The Council invites from members such communications in all branches of pure and applied physical chemistry, including electrochemistry and electrometallurgy.

ANNUAL GENERAL MEETING.

Notice is given that the Annual General Meeting will be held on Monday, November 20th. The nominations for officers and council will be announced in due course.

In future years the Annual General Meeting will be held in May, and the officers and council elected at that meeting will come into office the following October 1st.

FORTHCOMING MEETINGS.

An Ordinary Meeting will be held on Monday, June 26th.

On Monday, October 16th, there will be held a general discussion on "The Generation and Utilisation of Cold." There will be an afternoon and evening session, and the meeting will be held at the Institution of Electrical Engineers. Fuller particulars will be announced later.

Later in the year there will probably be a joint discussion with the Sheffield Section of the Institute of Metals on "The Corrosion of Non-ferrous Alloys."

Early in 1923 the Society will hold a general discussion on "The Physical Chemistry of the Photographic Plate."

ORDINARY MEETING, MONDAY, JUNE 26TH, 1922, AT 8 P.M., AT THE CHEMICAL SOCIETY.

BURLINGTON HOUSE, PICCADILLY, W.1.

Papers to be read:—

Professor Alfred W. Porter, F.R.S., President: "The Law of Distribution of Particles in Colloidal Suspensions with special reference to Perrin's Investigation."

W. R. Cooper: "The Electrochemical Effects Produced by Superimposing Alternating Currents upon Direct Currents."

Professor T. M. Lowry and E. E. Walker: "Properties of Powders, Part II.: Expansion and Shrinkage during Caking of Potassium Carbonate."

Professor T. M. Lowry and L. P. McHatton: "Properties of Powders, Part III.: The Powdering of Minerals by Decrepitation."

Dr. A. M. Williams: "Two Properties of Powders."

Dr. J. L. Haughton and G. Winifred Ford: "A note on the Systems in which Metals Crystallise."

A. J. Kieran: "The Electrical Conductivity of Hydrochloric Acid and Potassium Chloride in presence of Sucrose."

ROYAL SOCIETY OF ARTS.

June 23rd, at 4.30 p.m.: E. W. Woods, C.I.E., "Irrigation Enterprise in India."

NOTES ON BOOKS.

The Instant Interest and Discount Tables, published by Messrs. Bowman & Murdock, 99, Shoe Lane, E.C.4. Price 1s.

This compilation marks a distinct advance on any tables of the kind hitherto published. By a simple and ingenious arrangement, the interest of amounts from 1d. to £1,000 can be found instantly, at rates varying from $\frac{1}{4}$ th of 1 per cent. to 95 per cent.

A Textbook of Organic Chemistry, by J. S. CHAMBERLAIN, Ph.D. Pp. XLIII. + 959. London: George Routledge and Sons, Ltd., 1921. Price 16s. net.

The author has added another textbook on organic chemistry to the many already existing. It has few features of striking originality, and possesses the usual characteristics of this type of book.

Aliphatic and aromatic bodies are systematically discussed, and the fundamentals of this branch of science are presented in a manner eminently suitable for students.

A brief account of the separation, purification and analysis and molecular weight determinations is given in the form of an appendix, instead of early in the text as is customary. This seems a distinct advantage. No references are given to original papers, but this is unessential in a book of this type.

Very few errors have been noticed, but terephthalic and mandelic acids are repeatedly spelt in an unusual way.

As the book is quite up-to-date and published at a fairly reasonable price, it should commend itself to lecturers and their students. J.G.F.D.

Some Physico-Chemical Themes by A. W. STEWART, D.Sc. Pp. XII. + 419 + 5 plates. London: Longmans, Green and Co., 1922. Price 21s. net.

Professor Stewart has written a very readable volume on a number of interesting physico-chemical topics.

Some of the chapters have evidently been adapted from an early edition of his "Recent Advances in Physical and Inorganic Chemistry," by incorporating the results of later investigations.

A survey of the whole field of Physical Chemistry has not been attempted, the author having confined himself to a discussion of certain topics.

Critical readers may regret the omission of subjects in which they are interested, but in general, the matter has been well chosen.

From a consideration of double salts, the author passes on to a good description of Van 't Hoff's researches on the Stassfurt Salt Deposits. The theory of indicators, non-aqueous ionising media, colloids, adsorption, catalysis, and the development of the Periodic Law are among the many subjects considered.

It is very regrettable that the author loses no opportunity of attacking Ostwald. Whatever subsequent research may prove, it is beyond dispute that Ostwald has contributed considerably to the advancement of Science, both by his own researches and by his inspiration of others. His belief in the fundamental importance of energy and his preference for this concept in place of that of matter, has recently received much support from Einstein's theory of Relativity.

Professor Stewart's books on "Recent Advances in Chemical Science" appeal especially to students, both prior and after they have graduated. His present volume will also be very popular among them, and should be widely read by chemists generally. J.G.F.D.

Power Alcohol: Its Production and Utilisation. G. W. MONIER WILLIAMS, O.B.E., M.C., M.A., Ph.D. Pp. XII. + 323. Henry Frowde and Hodder & Stoughton, London. Price 21s. net.

In these days of increasing oil consumption a book dealing with the prospects of

any alternative or additional source of supply is welcome.

The first chapter is devoted to statistics on the production and consumption of motor fuel. The next chapters are devoted to a consideration of the plant as a source of alcohol, together with an account of the various systems of fermentation and distillation, and the principles underlying these. This is followed by an important chapter on the economies of alcohol production from crops in which the probable yields and cost of production of alcohol from various plants are discussed, from which it appears as if we cannot look for any great cheapening in the cost of motor fuel due to the use of alcohol.

The question of the production of alcohol from cellulose materials is then thoroughly considered, and also the synthetic production from ethylene and acetylene.

An account is then given of the various methods of excise supervision and denaturation employed in various countries.

The next chapter is devoted to the principles underlying the internal combustion engine, and an account is given of the important work of Richards, while the final chapters deal with a consideration of the properties of alcohol fuels, both from a chemical and physical standpoint, and also from the practical results of engine tests.

This book deals with the alcohol problem in a very well-balanced manner, and can be thoroughly recommended.

Full references to original papers, etc., are given, and these show the large amount of work which has been considered and is now made more available for practical use.

A.T.G.

Town Gas Manufacture, by RALPH STALEY, M.C. Pp. XI. + 108. London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.

This book commences with a chapter on coal and its handling, and then a description is given of the various systems of carbonisation, and also of water-gas and complete gasification processes. The course of the gas is then followed through the works, and chapters are devoted to the exhauster, wet and dry purification, naphthalene blockages, gas measurement and storage, and finally there is a chapter on the manufacture of sulphate of ammonia. In each

chapter illustrations are given of most of the types of plant described, and in some cases useful notes as to yields, etc., are added.

The book is written in a non-technical manner, and is very suitable for those who wish to obtain a general idea of the processes of town gas manufacture and purification.

A.T.G.

PHOSPHORUS IN HEMATITE IRON.

CONTAINING UP TO ABOUT 0.2% PHOSPHORUS, 0.5% TITANIUM, AND 0.15% ARSENIC.

Short modification of the "Concentration" method (*Proc. Cleve. Inst. Eng.*, Feb., 1920, and *Chemical News*, May 7th, 1920) for Works Purposes where the Greatest Speed consistent with a high degree of accuracy is paramount.

The principle of the method is identical with that of the "Concentration" method referred to above, the accuracy of which has been thoroughly established not only by the author, but by a number of other chemists in Great Britain. In outline it consists of precipitating the phosphorus in the presence of graphite, etc., with a large excess of nitromolybdate, in a very concentrated solution, in order to overcome the retarding influence of titanium; then re-dissolving this precipitate, which is more or less contaminated with arsenic, silica, etc., through the filter and purifying it by re-precipitation.

DETAILS OF MODIFIED METHOD.

To 2 grams of fine drillings in a covered 400 cc. tall form beaker having a graduation mark at 50 cc., add gradually a mixture of just 15 cc. nitric acid (s.g. 1.42) diluted to 30 cc. with water. Simmer gently, with the cover on, so as to avoid unnecessary loss by evaporation. Most samples dissolve without difficulty in 15-30 minutes, allowing the silicon to pass into solution and leaving an almost silica-free graphitic residue. In all but unusually silicious irons, by proceeding at once with the analysis, the first precipitation of the phospho-molybdate may be readily effected without any appreciable amount of gelatinous silicic acid separating out; if, however, large gelatinous clots are observed, or if it is desired to hasten the dissolving, add with aluminium tongs 1 compressed reagent containing NH_4HF 1 gram, agitate the beaker for a few seconds till the tablet has disintegrated, then boil the contents of the

covered beaker *gently* a few minutes till the silicious clots, often noticeable at first, mostly disappear.

Without removing the graphite, proceed at once to add with the aid of aluminum tongs 1 compressed reagent (pot. permang. 0.25 grms.) and simmer gently for about two minutes to completely convert the phosphorus to orthophosphate.

Add two compressed reagents containing in all, am. oxal. 0.6 grms., ammon nitrate 7.7 grms., and am. chloride 1.5 grms. These dissolve the manganese oxides and at the same time introduce the necessary ammonium salts for the precipitation of the phosphorus.

Simmer about 2 minutes after the solution has cleared; add just 12 cc. conc. nitric acid (s.g. 1.42) by pouring down the sides whilst rotating the beaker, and as soon as the solution boils, remove the cover without rinsing it, lift the beaker off the heater and precipitate the phosphorus—contaminated with more or less arsenic, silica, etc.—by pouring into the middle of it, whilst swirling it 20 cc. of conc. ammonium molybdate solution (150 grms. per litre, faintly ammoniacal).

Agitate vigorously for a full two minutes (timed), and then allow the liquid to stand at atmospheric temperature for not less than 5 minutes. The phosphorus will now be completely precipitated, even if there is as little as 0.02 per cent., with as much as 0.5 per cent. titanium.

Filter through a small paper pulp filter, preferably without using suction, prepared as previously described by the author. Rinse in and wash four or five times, using about 10 cc. liquid each time—i.e., just sufficient to remove all but occluded iron salts—with nitric acid water [20 cc. (s.g. 1.42) per litre of water]. As usual, don't wash any more than is just necessary.

Place a small 100 cc. beaker under the funnel, and pour on to the pulp 10 cc. of nearly boiling citric* acid solution (25 grams per litre). When this has just percolated through, pour on 5 cc. cold diluted ammonia solution [15 cc. conc. ammonia (s.g. 0.880) diluted to 100 cc. with cold distilled water] and allow to drain into the same beaker.

Return the combined filtrate through the pulp, receiving it in the original 400 cc. beaker having a graduation mark at 50 cc. Rinse the 100 cc. beaker with fine nozzle and wash the pulp with boiling water 4 or 5 times, using a broad nozzle so as to add the minimum wash water (8-10 cc.) to completely cover the pad of pulp.

If these instructions are observed, the whole of the phosphorus will be in the clear filtrate, measuring only about 50 cc., and the graphite silica, etc., will remain on the pulp.

If necessary, evaporate the clear filtrate down to the 50 cc. mark on the beaker; remove the beaker from the source of heat, and to the 50 cc. of liquid at about 100 deg. C. add 50 cc. of cold (12°-16° C.) ferric-nitro-molybdate reagent and re-precipitate the phosphorus—free from arsenic, silica, etc.—at about 60 deg. C., agitating continuously for 2 full minutes and allowing to stand 5 minutes at atmospheric temperature. If the arsenic is likely to be above 0.05 per cent. this period of standing should not be exceeded.

Filter through pulp, wash with 0.1 per cent. pot. nitrate solution, and titrate with N/6.74 NaOO and HNO₃ exactly as described formerly by the author.

Whilst the instructions throughout the method should be carefully followed, there is no difficulty in keeping within the allowable limits as to volumes, temperatures, etc.

Ferric-nitro-molybdate.—This solution is made up according to the instructions furnished with the original "Concentration" Method described in the *Proc. Clev. Inst. Eng.*, Feb., 1920, and on page 220 of *Chemical News*, May 7th, 1920.

A single test may be made within an hour. Although this is only 10 or 15 minutes shorter than the "Concentration" Method formerly described, there is a much greater proportionate saving when doing several tests together, as there are appreciably fewer operations, and not so much continuous attention is required.

The use of compressed reagents—which are being increasingly employed to facilitate analysis—is found particularly helpful in

* The object of adding the hot citric acid first is to saturate the precipitate with it, so that on adding the ammonia to dissolve the phospho-molybdate, any traces of iron occluded with the precipitate are converted into soluble ferric citrate, thus ensuring

complete solution of the phosphorus and avoiding the possibility of any trace of it being precipitated as ferric phosphate, which would remain on the filter and thereby make the results low.

this method in which success is largely dependent on readily maintaining very concentrated solutions.

Careful experiments have proved that this method is comparable in accuracy with the

best known and much more elaborate methods for phosphorus in titaniferous or arsenical hematite iron, and every trial test made by it on standard samples has been within 0.002 per cent. of the standard figure. A few of the results are given below:

Description of sample.	% Ti (total).	% As.	% P. Std figure.	% P. found.
B.C.Std Iron "A"	0.05	0.04	0.040	0.0495
B.C.Std Iron "B"	0.11	0.03	0.026	0.0275
Sample East Coast	0.12	?	0.058	0.059
B.C.Std iron "A" + 0.35% Ti.	0.12	0.04	0.049	0.050
Sample W. Coast + 0.13% Ti.	0.40	?	0.030	0.030
B.C.Std iron "A" + 0.10% As.	0.40	0.14	0.049	0.050
B.C.S. Iron "B" 0.10% As.	0.05	0.13	0.026	0.028
4.2% silicon steel	0.11	?	0.043	0.043
B.C. Std iron "B"	none	0.03	0.026	0.026 &
			Fluoride reagent added	0.0255

N. D. RIDSDALE.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 14408—Coke & Gas Ovens, Ltd.—Apparatus for dehydrating tar. May 22.
- 14537—Farbwerke vorm. Meister Lucius & Bruning.—Manufacture of sulphonic acids of the 2:3-oxynaphthoic acid artilides. May 23.
- 14592—Ferguson, J. B. P.—Manufacture of calcium lactate and lactic acid from fermentable sugar solutions. May 24.
- 14655—Soc. Chimiques des Usines du Rhone.—Process for preparation of basic salicylate of alumina. May 24.
- 14768—Techno Chemical Laboratories, Ltd.—Rotatable heat-transmitting appliances. May 25.

Specifications Published This Week.

- 156,800—Norsk Hydro-Elektrisk Kvaestofaktieselskab.—Process of converting nitrous gases into concentrated nitric acid.
- 156,799—Norsk Hydro-Elektrisk Kvaestofaktieselskab.—Manufacture of concentrated nitrous gases.

157,750—Lehmann-Metall Ges.—Process for the manufacture of pieces of tungsten or molybdenum carbide of any desired size.

160,759—Amour Fertilizer Works.—Production of aluminium chloride.

179,723—Hansford, J. B.—Apparatus for drying sulphate of ammonia and other chemical salts.

179,753—Lewcock, W.—Production of aminophenols or aromatic amino-acids.

Abstract Published This Week.

Ferrous Sulphate; Hydrochloric Acid.—Patent No. 177,444.—Messrs. E. V. Chambers, of the Manse, and T. C. Hammond, of Hopewell, both in Lightcliffe, have obtained a patent for a process of treating waste ferrous chloride liquors by heating with sulphuric acid, to obtain ferrous sulphate. The hydrogen chloride and steam evolved being condensed. The apparatus comprises storage tanks in which the filtered liquors are treated with the required amount of sulphuric acid, and from which they are pumped to an overhead tank. Thence the liquors pass to a series of basins arranged in cascade form. This cascade is enclosed, and is heated by a furnace at its lower end. The fumes evolved from the heated liquors are condensed and hydrochloric acid is obtained in the receiver. A scrubbing tower filled with coke forms part of the condensation apparatus, and any fumes not condensed therein are drawn off through the chimney stack of the furnace. The liquors discharged from the cascade contain ferrous sulphate, which is allowed to crystallize in the tanks. The mother liquor, collected in the tank, is pumped back to one of the storage tanks to be re-treated.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

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ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

ANNUAL CONFERENCE, 1922.

ADDRESS BY THE PRESIDENT (MR. J. PALEY YORKE).

(Continued from Last Week.)

Technical education is not outside the boundaries of this fair country which I have called a good general education. There are some who would have us believe that it is, and who would be stricken with horror at the suggestion that a Junior Technical School might produce boys whose general education could be compared favourably with that of boys of equal age in Secondary Schools.

THE INDUSTRY OF THE TECHNICAL STUDENT.

In urging that Technical Education has a right to be considered I would ask for careful investigation of the old idea that anything which approaches the region of usefulness cannot possibly be of any educational value. It was once a golden rule that educational subjects, to be educational, should be uninteresting, difficult, and useless. Modern teachers recognise that the first essential is the stimulation of interest.

Look inside our Technical Institutions and see whether there is interest or not. In them there is sterner work and less opportunity for recreation—unhappily—than in any university college. The student is the keenest of all students—partly, no doubt, because he feels that his work is shot through with significance, and that he is not doing it merely because it is the proper thing for people in his set to do. It is said often that the attitude of the average undergraduate at college is summed up by the slogan, "We are here because we're here." That is probably a libel on the average undergraduate: it could never be applied to the student in the Technical Institute. There you will find application and energy which would stagger the imagination of the slothful. Above all do you find it in the

evening classes, where men diligently pursue knowledge night after night for years on end, handicapped unmercifully by physical tiredness after the day's work, and in too many cases by the unsoundness of their fundamental education.

These are men who fill us with admiration, command our deepest respect, and who keep alive in us that enthusiasm without which no man can ever hope to teach or to inspire his students.

The cynic and the superior person will say at once that the earnestness of these students is measured by their desire to earn more money! But is it not really the desire to obtain the means for living a wider and fuller life? Would the cynic deny him that? Does the cynic's position in life depend in any way upon his education, and is he prepared to give up all his bodily comforts and take pleasure only in his cultural superiority? Let us be fair to the technical student of the evening classes, and let us realise that whatever may be the primary instinct which bids him to seek knowledge the net result will be the gaining of knowledge, and with the gain an increased breadth of vision and a greater sense of responsibility to himself and his fellow men.

It is one of our regrets that so few people know exactly what our Technical Institutions are doing. Even amongst the social workers there are very few who have any real idea of what goes on inside their doors. Members of education committees and even members of the advisory committees of institutions are to be numbered amongst the great majority who have no real knowledge of what is being done—and especially of what is being done in the evening classes.

EVENING CLASSES.

Suggestions are being made that many evening classes should be shut down in the interests of economy. We have no desire to bolster up any classes for which there is no response and in which no work of importance is carried on, but we do hope that the greatest care will be exercised in deciding what shall be abandoned and what shall be retained. We would particularly point out the danger which would result if the purely quantitative method of estimating the importance of all classes be adopted. There is generally a tendency on the part of education authorities to declare that unless the entries for a class reach a certain number the class should not be opened. On the surface this seems reasonable enough: my

complaint is that the same number is taken as the standard of measurement for all classes, whether very elementary or very advanced. In the same way classes are are closed down during a session should the attendance fall to the level of this certain number. Again the idea is quite reasonable, but I do contend that there should be no common denominator, and that account should be taken both of the subject of the class and the stage or year of the class. Surely a class of N students attending a fourth or fifth year course of a subject is of greater importance and national value than N students in their first year course! These advanced students have passed through the testing fires and have attained the zest of disciples. Through them the teacher might, and in all probability would, influence ultimately more people than the teacher who measures his beginners by the hundred. Higher classes must necessarily be smaller than elementary classes: in each successive year the sifting mesh becomes finer and finer. After so much sifting and sorting are we going to throw away the product of our labours? This is a point over which the Association must keep a close watch *in the interests of economy*.

THE BURNHAM REPORT.

I hope that at a professional conference your President may make reference to matters of common interest to the State and to the profession without bringing abuse upon his head and without laying the conference open to the charge that it is only concerned with the self-interest of its members. It was not possible at the last conference for any reference to be made to the report of the Burnham Committee for technical, etc., schools. The recommendations of that committee are now so well known that it is hardly necessary for me to say anything about them at this conference. There was much to cause disappointment to technical teachers. Although we were assured that we should not be prejudiced (compared with Primary and Secondary Teachers) because of the fact that our report had to be taken third in order, yet we were penalised—not deliberately perhaps (except in the matter of the date of operation) but by the circumstances of the time when our case was being considered. However, that is past history. The report was drawn up and agreed to, and we welcomed it in that it was a scheme on a national

basis agreed to by representatives of the local Education Authorities on the one hand and by the representatives of the teachers concerned in the report on the other hand, and approved by the Board of Education on behalf of the national government. The report represents a result of collective bargaining: and it represents a distinct advance in the relationship between the local Education Authorities, the teachers, and the national authority, and it should bring about—and personally I feel sure that it will bring about—better mutual understanding and appreciation.

But it is a matter of very grave concern to us that certain Education Authorities have so far repudiated the agreement and have refused to give full effect to the recommendations of the Burnham reports. To the average British mind the recommendations of a report of that kind—an agreement between the parties concerned—are more binding than any Act of Parliament on the Statute book. Thus the spectacle of any public body repudiating an agreement and refusing to carry it into effect is one which must cause alarm to every thinking man and woman who has so far regarded the moral integrity of British public bodies as being beyond reproach.

What an example to show at an epoch in history when man is striving to come to a better and freer understanding of his fellow man and when the principles of collective bargaining and round-table Conferences are being urged in place of the disastrous conflicts of the past as being more civilised and more humane.

Some local authorities have put the Burnham recommendations for primary and secondary teachers into operation and have then refused to honour the technical agreement! This is even more incomprehensible than wholesale repudiation, and argues a lack of appreciation of the fundamental principles of equity and fair-play and a lack of understanding of British psychology. The electorate is blamed: but the electorate has not been asked for its opinion on facts.

We would ask those local education authorities who are not honouring the agreement what sort of a reputation they will establish for themselves, and whether they think that their action is likely to attract into their area any but those who cannot find employment elsewhere or to retain

teachers in their employment for a day longer than they are compelled to remain. What guarantee can they offer for the sanctity of agreements?

APPRECIATION OF NON-TEACHER EDUCATIONISTS' WORK.

That is all I propose to say about the Burnham report in this address except to express my appreciation of the labours of the members of the committee. Particularly would I like to express my very keen appreciation of the labours of the non-teacher members of the committee. Lord Burnham was the perfect chairman, and the hours and hours of service which he gave to us make us his debtors for all time. And when I say "us," I mean local education authorities as well as teachers. I would also ask this conference to recollect that the representatives of local education authorities were for the most part business men and that the service they were rendering was proof of their interest in education. That service was rendered in hours snatched from their own business interests or in hours which might have been leisure hours; and it was rendered without any ulterior motives. Whilst I do not suggest that I endorse all their views or approve all their recommendations, I do appreciate their labours in the common cause, and would ask this conference to endorse that appreciation.

Whilst I am sounding this note I think that greater recognition might be given to the labours of Education Committees and Advisory Committees up and down the country. They are composed of hard-working public-spirited and eminently desirable men and women, and the country owes them a far greater debt of gratitude than it has knowledge of. The service which they render on education committees make them unpopular with the Borough and County Councils, and almost invariably subjects them to unjust accusations. Education committees themselves are not local authorities—but they are too often regarded as such when blame is being apportioned. I recognise their difficulties and appreciate their work, and whilst commending their courage generally I would urge that they should have more. And if I could beg an additional few hours of their service during the year—I know that I am asking for much—I would urge some visits to the Technical Institutions.

Finally I would urge that they should express their real convictions, and not seek refuge behind the possible opposition of a council or the alleged opposition of an electorate before which the facts may never be presented.

THE PENSIONS PROPOSALS.

Amongst the Government's proposals for reduction in the Education estimates is that of making the pension scheme for teachers contributory. Again I hope that I may be allowed to make some reference to the proposal because again it is a matter between the State on the one hand and ourselves on the other, and a remarkable principle is going to be introduced if no profession may criticise a State proposal without bringing down upon its head the charge of selfishness. The great point which the Government made was that the scale of salaries were agreed upon, and that to alter this would be a breach of faith. But, they argue, there would be no breach of faith in converting a pension scheme which was inaugurated as non-contributory and passed by Parliament as non-contributory into a contributory scheme. Our contention is that such would be a breach of faith and would in effect be equivalent to a direct cut in salaries. It would be a breach of faith because the salary scale agreed upon duly took the pension scheme into account, and had the Burnham Committee been told that there was any possibility of the pension scheme being altered so materially there would have been a corresponding alteration in the agreed scales.

Further, it is difficult to see upon what principle of equity it is proposed to levy a tax on teachers' pensions whilst the pensions of other national servants are to remain on their original basis. The principle of relativity is not confined to the movement of planets relatively to one another. There are very few absolute standards of measurement. Comparison is the usual basis of measurement, and whilst it may be odious it is also human and even necessary.

It is also difficult to see how the Government conscience is going to be soothed when considering the cases of those of us who, previous to the inauguration of the national scheme, were participants in local schemes in which the benefits were no less and to which there was a contribution at a lower percentage rate than the Government propose. When a teacher changed over

from local to national did he contemplate for an instant the possibility of the Government scheme being materially altered? Is there no question of breach of faith in this proposal?

WHAT IS A FULL-TIME TEACHER?

Whilst on the subject of pensions, I feel that attention must again be drawn to the extremely unsatisfactory position in which we technical teachers find ourselves. There are two main points. The first is that no information is yet available to us as to our exact position on that scheme: the second is the apparently extraordinary attitude of the authorities on the definition of a "full-time teacher."

In one sense the first point which I have mentioned turns upon the second. The Act says in effect that full-time teaching service shall be recognised as pensionable service, and it would appear that the Government seeks to make some definition of the phrase "full-time teacher," which will reduce both the number of technical teachers who could possibly benefit by the scheme and the number of years of service under which pension could be claimed. We have a very distinct grievance here: very definite, very serious, and a heavy penalty on Technical Teachers.

The whole trouble would appear to arise from the fact that technical teachers have to work very largely on the split-shift system. No difficulty arises in the recognition of a full-time teacher in a Primary or Secondary school; but because the technical teacher has to work mornings and evenings on some days, afternoon and evenings on other days, and mornings and afternoons on others, the Government professes to be unable to say whether he is a full-time teacher or not. The presumption is that it desires to count him out. The Burnham Committee defined a full-time teacher as distinct from a part-time teacher, as one who held a full-time appointment. That appears to be insufficient for the Government, and they now seem to be seeking to define a full-time teacher in terms of hours of active teaching and of actual attendance as to create a most serious position. The hours of service of the Primary and Secondary teachers are unquestioned—but because the Technical man has to endure the hardships of split shifts, the social isolation it entails, and the greater strain upon his endurance and fortitude, his service is to be questioned as full-time service. This, too, in spite of the fact that the terms of his appointment invariably stipulate that he

"shall give his whole time to the duties of the post and shall not take up any other appointment."

The net result is that we none of us know what benefits, if any—are likely to come to us under the pension scheme. It is an intolerable position, and whilst we recognise that the clerical work involved in giving definite information to any individual may be so great that it will take a few years to give it to everyone, we can see no reason why the general principles of recognition should not be stated definitely. We urge this very strongly indeed, and in doing so express the very firm opinion that all service rendered in a "full-time appointment" should be recognised as pensionable service.

The hesitation in doing so can only be put down as an example of the lack of knowledge of the work of Technical teachers.

THE PLACE OF THE PART-TIME TEACHER.

The place of the part-time teacher in the scheme of Technical education is one in which we are keenly interested. It is of the greatest importance that we should keep in touch with industrial development and industrial problems. In certain branches and stages of technical education it is quite impossible for a full-time teacher to have the same detailed knowledge of current practice and current problems as a man actively engaged in the industry or profession. If the service of someone actively engaged in some responsible and authoritative position can be obtained as a part-time teacher his work will be the flux which will help to weld together fundamental scientific principles underlying the industry and the actual practice obtaining. Such work is of extreme importance, and the part-time teacher of the type indicated must be regarded as an essential factor of any scheme of Technical Education.

(To be continued.)

DEHYDROTHIOTOLUIDIN: ITS ISOMERS, HOMOLOGUES, ANALOGUES, AND DERIVATIVES.

By MARTIN MEYER, B.Sc., M.A.
NEW YORK CITY.

(Continued from Last Week.)

EXPERIMENTS.

PART A—BENZOTHAZOLES.

1. *Oralamino-thiophenol.*

In order to become familiar with the technique of the preparation of these com-

pounds, this synthesis was attempted as a starting point, since it involves a sulphur fusion which may be considered typical. 300 g. of acetanilide was heated with 180 g. of powdered roll sulphur following the directions of A. W. Hofmann.⁴⁸ The weight of the melt at this point was 282 g., which was then treated according to the directions of Lauth⁴⁹ for extracting the pure compound. 60 per cent. sulphuric acid, by weight, extracted only 140 g. of the melt corresponding to a 50 per cent. yield against 60-70 per cent. as given by the original article. Crystallization from boiling aniline yielded a coloured product, and as the solubility in ethyl alcohol is less than 1 g. per 100 cc., and it is equally or more insoluble in ether, nitrobenzene, aniline, amyl alcohol, amyl acetate, and mixtures of these, it was decided that purification by other methods than sublimation was impracticable. Sublimation of 75 g. yielded 7 g. of white, odourless needles, melting at 304° (Unc.), which was then recrystallized from a large volume of ethyl alcohol. The final yield, calculated back, was less than 5 per cent. of the acetanilide used, and was considerably less than that given by either of the previous investigators.

The extreme minuteness of the yields proved to be a regular occurrence in all similar experiments, and this, as well as the difficulty in obtaining the intermediates required, was a continual source of vexation and a serious handicap to the progress of the work. For this reason the synthesis in each case are given fairly completely to save time wherever it may be necessary or desirable to duplicate or continue the work. The yields described in this dissertation have all been actually obtained and can be duplicated by fairly careful manipulation.

In accordance with the first and third purposes of this research, it was considered desirable to prepare a homologue of the "Rosenkörper" and to determine whether it would exhibit an odour resembling that of the interesting substance obtained by Hofmann. With all the methods, previously enumerated, available, it was decided to attempt the synthesis of 2-paratolyl-benzothiazole, which, if successful, would be a new contribution to the

chemistry of the group, by the original method of Hofmann, which should proceed as follows:



Paratolanilide was required as a starting material, and as it was not available, the synthesis was performed accomplished from paratoluidin.

2. Paratolulyl Nitrile.

This compound was made following the directions of Gatterman⁵⁰ and of Fisher.⁵¹ The reaction proceeds as described, and the yields and melting points coincide with the accepted ones.

3. Paratoluic Acid.

Prepared according to the directions of Gatterman and Fisher as just given. Yield and M.P. were as recorded.

4. Paratolulyl Chloride.

As first attempted, a method adopted from Gatterman's⁵⁰ preparation of benzoyl chloride was employed. The reaction does not proceed satisfactorily, and after two trials it was discarded.

The compound was synthesized by the method of Frankland and Wharton⁵² (see also F. and Aston) and the yield was 55-60 per cent. of product boiling from 182° C.-185° C. at a pressure of 260 mm.

5. Paratolanilide.

The literature furnishes a number of methods for this synthesis by Wegerhoff,⁵³ Brückner,⁵⁴ Fischli,⁵⁵ and Leuckhardt,⁵⁶ and the observed melting points vary from 139° C. (Fischli) to 145° C. (Leuckhardt).

Since paratolulyl chloride was available from the previous synthesis, the method of Fischli was selected and modified.

In a one litre flask, dissolve 15 g. (18 cc.) of freshly distilled aniline in 200 cc. of

50. Gatterman, *Practical Methods of Org. Chem.*

51. Fisher, *Lab. Man. of Org. Chem.*

52. Frankland & Wharton, *J. Chem. Soc.*, 69, 1311 (1896).

Frankland & Aston, *J. Chem. Soc.*, 75, 484 (1899).

53. Wegerhoff, *Ann.*, 252-12 (1889).

54. Brückner, *Ann.*, 205-132 (1880).

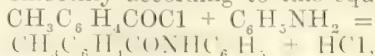
55. Fischli, *Berichte*, 12, 615 (1879).

56. Leuckhardt, *Jour. Prakt. Chem.* (2), 41, 306 (1890).

48. Hofmann (see 12).

49. Lauth (see 39).

water-and alcohol-free ether. From a dropping funnel add slowly with good stirring 25 g. of paratolyl chloride. The reaction proceeds smoothly according to this equation:



the product separating out at once as a fine white precipitate. Evaporate off the ether, or better, distill off on a water bath, and dissolve the residue in the least amount of 50 per cent. ethyl alcohol, in which the solubility is about 5 g. per 100 cc., by warming. Allow to cool, filter by suction, and wash with cold water. The yield is practically quantitative, and the purity of the product is satisfactory for most purposes. On recrystallization from ethyl alcohol it appears in shining white plates, M.P. 145° C. (cor.).

6. 2-Paratolyl Benzothiazole (A).

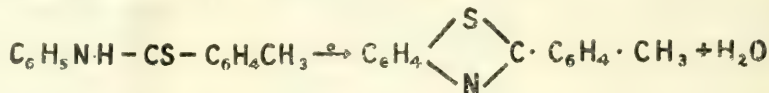
The first attempt to prepare this compound was, as has already been mentioned, according to Hofmann's first general

It was thought, however, that the direct fusion of the two substances might have been responsible for the low yield, due to too powerful oxidation and consequent charring, and accordingly the addition of naphthalene as a diluent was next tried. The melts were made up as follows:

Paratolanilide	12 g.
Naphthalene	12 g.
Roll Sulphur	6 g.

according to the method described later for dehydrothiotoluidin. They were heated for two hours starting at 160° and ending at 200°. At the end of the first hour a marked colour change to yellow occurs, but the desired substance was not found in the final mixture.

Hofmann's method for preparing the desired compound having failed, it was next decided to attempt its synthesis analogously to the method by which Jacobson⁵⁸ had obtained the "Rosenkörper," for which the reaction should be in this case:



method, the fusion of the anilide with sulphur.⁵⁷ A mixture of two parts by weight of paratolanilide and one part of powdered roll sulphur was placed in a flask equipped with a reflux air condenser, and kept at a temperature of 290° to 300° C. for two hours on an oil bath. At the end of this time the melt was poured into a beaker, allowed to solidify, and powdered. The weight of the fusion mixture at this point was 1.5 to 1.6 parts in several experiments, and was dark brown in colour. It was extracted repeatedly with 100 cc. portions of concentrated hydrochloric acid (39 per cent. HCl by weight, specific gravity, 1.2) and the liquid extract diluted with water, but no precipitate formed. On neutralization with sodium carbonate and long standing, a small amount of yellow material, insufficient to purify, was deposited, and a solution of this in alcohol and in concentrated hydrochloric acid gave a yellow precipitate with 1 per cent. gold chloride solution, a reaction which is characteristic of these bases. Alcohol and ether extractions of the melt gave similar results, and it is probable that the yield of the desired substance in the reaction is positive, but certainly less than 1 per cent.

Thioparatolanilide was required as a starting substance and as this was not available, it was again necessary to prepare a number of intermediates.

7. Thiocarbanilide.

Prepared from aniline and carbon disulphide according to Gatterman.

8. Phenyl Mustard Oil.

This was made from thiocarbanilide as described by Gatterman.⁵⁹

9. Thioparatolanilide.

This compound was synthesized by the method of Gatterman, whose method is simpler than that of Leo, which has already been mentioned in the introduction. Since the substance was required in fairly large quantities, it was found necessary to modify the original method somewhat, as it is undesirable to use amounts much larger than those in the above-mentioned paper, because of the tendency of the aluminium chloride to cake, with an accompanying reduction in yield. It is preferable

58. (See 15).

59. Gatterman, *Jour. Pr. Chem.* (2), 52, 575 (1899).

(See also Friedman and G., *Berichte*, 25, 3527 (1892).

57. (See 5, 12, 25, and 27).

to carry out the reactions in separate vessels. The ensuing directions involve about the maximum quantities with which it is possible to secure satisfactory results, but by running a number side by side, much more can be made without a great increase in the time necessary, and with very good yields.

A mixture of 15 g. of phenyl mustard oil, 30 g. of toluene and 30 g. of aluminium chloride (anhydrous) is allowed to stand, in a one litre flask with an electric stirrer, on a water bath for two hours, and then to complete the reaction, is left over night. Decompose the solid reaction product carefully with ice water, and distill off the unchanged toluene and phenyl mustard oil with steam. On more than one run this may, of course, be done successively with the same apparatus. The residual liquid in the flask is poured into a beaker and deposits, on cooling, a solid which consists chiefly of the anilide, but contains some alkali-insoluble impurities. Filter off, and if more than one preparation is being made, unite the yields at this point.

Warm the solid material with 10 per cent. KOH using 300 cc. to each run, and filter. Extract a second time, using 150 cc. to each. (The solubility of the anilide is about 9.2 g. per 100 cc. in the dilute alkali at 20° C.) Unite the filtrates and neutralise with 20 per cent. sulphuric acid. Yield is 80 per cent. of the theory, and the purity is sufficient for most purposes. (This yield may be cut to 40 per cent. simply by using double the quantities directed.)

Thioparatolanilide may be recrystallised from ethyl alcohol, in which the solubility at the boiling point is about 30 g. per 100 cc., in which it gives a red solution, which on cooling, deposits yellow needles melting at 142° C. (cor.).

10. *Paratolylbenzothiazole* (B).

From the compound just described, the new sulphur base was prepared successfully by an adaptation of the method of Jacobson.⁶⁰

In a litre beaker, dissolve 16 g. of thioparatolanilide in 700 cc. of water containing 60 g. of sodium hydroxide. (An equal weight of potassium hydroxide can be used with the same results.) It is necessary to warm to effect solution. Allow to cool to

room temperature and add 227 cc. of a 20 per cent. solution (containing 45 g. of solute) of potassium ferrieyanide. The mixture becomes milky yellow at once. Allow to stand twenty-four hours and filter off the resinous precipitate.

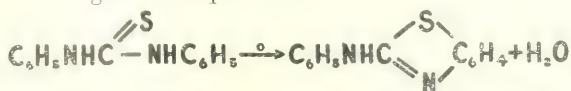
Extract twice with 150 cc. and 100 cc. of concentrated hydrochloric acid respectively, filtering through asbestos each time. The solid becomes a bright red at first, on addition of the acid. Mix the extracts and drown them in ten times their volume of water. After extraction all but a small amount of material which is an oil below 100°, but solidifies to a gummy mass, should have dissolved. The precipitate on the addition of water is voluminous and pale yellow in colour. The weight is 60-75 per cent. of the theory according to the equation given above. There is no advantage in neutralising the acid with sodium carbonate.

Absolute purity requires several recrystallisations from alcohol, as the impurities, though small in quantity, are difficult to remove, which finally yields it in colourless, odourless needles, melting at 85° C. (cor.). When slightly moist with alcohol, the new base has a faint odour which is somewhat suggestive of "Rosenkörper," but its intensity is so small as to be barely perceptible. *Analysis*:

Calculated for $C_{11}H_{11}NS$	$N = 6.22\%$
Found	$N = \begin{cases} 6.55\% \\ 6.46\% \end{cases}$

11. *2-Phenylaminobenzothiazole*.

In the light of the synthesis just given, it occurred to the author that the 2 phenylaminobenzothiazole which has previously been prepared by Hofmann and others, should be formed by the oxidation of thiocarbanilid in the Jacobson reaction, according to the equation:



Accordingly the experiment just described was repeated, using the same molecular quantity of thiocarbanilid instead of thioparatolanilide. The precipitate which formed in the oxidation mixture was found to be practically insoluble in concentrated hydrochloric acid, the liquid extract on dilution with water depositing only a trace of gray-white substance which on a single crystallisation from ethyl alcohol melted at

60. (See 15).

144.5° C. (cor.) and may have been the desired compound, but the amount was too small to identify. The residue was yellow in colour and had lost very little in weight, and from it a substance soluble in alcohol, from which it crystallised in yellow needles melting at 237.5° C., was isolated.

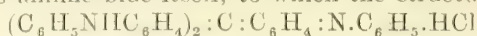
At the end of one of his papers, Jacobson makes a brief reference to having tried this reaction, and mentions carbanilid as one of the products, the other being an amorphous, insoluble material that was not investigated. This may be prepared as follows:

Dissolve by heating, 18.0 g. of thiocarbanilide in 800 cc. of water to which has been added 60 g. of sodium hydroxide. All will not quite dissolve. Cool and add a solution of 52 g. of potassium ferricyanide in 260 cc. of water. Let stand 24 hours, filter, and dry. Residue is yellow in colour, and weighs 16 g.

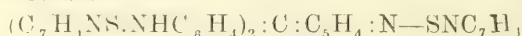
Extract with 150 cc. of 95 per cent. ethyl alcohol by heating. Filter. A second extraction is unnecessary. The residue is yellow, weighs 7 g., is highly insoluble in all ordinary solvents, except nitrobenzene, from which, however, it was not successfully crystallised, and is evidently the product mentioned by Jacobson. After some difficulty, his other observation was also verified. The filtrate was allowed to crystallise, and then the product repeatedly crystallised from alcohol, yielding finally a substance melting only slightly below carbanilid but exhibiting a yellow colour and giving a qualitative test for sulphur. It was attempted to hydrolyze this compound, using 30 per cent. aqueous potassium hydroxide, and 20 per cent. alcoholic potash in different experiments. Both yielded the same substance, which appeared in white, shining needles on recrystallisation from ethyl alcohol, melted at 238° C. (cor.), were free from sulphur, and gave the bromine addition product characteristic of carbanilid. (As did also the original substance.) Contrary to the test given by Mulliken⁶¹ carbanilid is apparently not hydrolyzed rapidly by alcoholic potash which does, however, remove the sulphur-bearing impurity. This can also be done by shaking the original material with alcohol in which the carbanilide dissolves more rapidly and leaves a small amount of yellow material,

too little to examine, however, at the bottom of the vessel. The extreme insolubility of the first substance made impossible any further investigation of it.

The aniline blues and reds are among the most important of the triphenylmethane dyes and have been prepared in a number of ways, from benzyl chloride, para rosaniline, and aniline, diphenyl amine, etc.,⁶² and of this group probably the best known is aniline blue itself, to which the structure



is ordinarily assigned. The last mentioned synthesis of this compound suggested that, since phenylaminobenzothiazole contains a secondary nitrogen group and is structurally closely related to diphenylamine, it would react similarly in the Hausdörfer reaction, yielding upon fusion with oxalic acid, a substance whose probable structure would be



Reasoning by analogy, this compound should be a direct silk dye and probably have a colour in the blue-green region of the spectrum.

As has been previously noted, phenyl aminobenzothiazole has been synthesized by a number of methods which may be briefly summarised:

(1) From phenyl mustard oil and phosphorus pentachloride, followed by treatment with aniline, by Hofmann.⁶³

(2) From anisyl and thioanisyl mustard oils by Hofmann.⁶⁴

(3) By Jacobson and Frankenbacher from phenyl mustard oil and azo-benzene.⁶⁵

(4) By hydrolysis of the dibrom addition product of thiocarbanilid with sodium carbonate, by Hugershoff.⁶⁶

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62. Fischer, *Berichte*, 15, 678 (1882).
 Nötling, *Berichte*, 15, 1453 (1882).
 Zimmerman & Müller, *Berichte*, 18, 993 (1885).
 Hausdörfer, *Berichte*, 23, 1963 (1890).
 Nötling, *Berichte*, 24, 553 (1891).
 Weil, *Berichte*, 29, 2677 (1896).
 Hofmann, *Ann.*, 132, 160 (1864).
 Wedekind, *Ann.*, 307, 291 (1899).
Central Blatt, 1908, 510; *D. R. P.* 67013.
Jahres Ber. Chem., 1863, 418.

63. (See 3).

64. Hofmann, *Berichte*, 20, 1176 (1887).

65. (See 36).

66. Hugershoff, *Berichte*, 36, 3127 (1903).

61. Mulliken, "Identification of Pure Organic Compounds."

Consideration of the methods available led to the selection of the fourth as being the simplest both from the standpoint of manipulation, and ease in obtaining the necessary reagents, for the difficulty in preparing starting materials was a continually vexatious matter in the course of this research. Accordingly the compound was prepared by the method of Hegershoff, which was found to yield the amount of product recorded by him, in a good state of purity, with a great deal of unnecessary labour, a thing which in almost every preparation in the thiazole field was a decided handicap, for many of the reactions which were met with during this work, did not give the yields which the context would seem to indicate, and the problem of purification is always a peculiarly difficult one because of the number and nature of the by-products of the reactions, as well as in many cases the extreme insolubility of the principal substance in most ordinary solvents.

2-Phenylaminobenzothiazole is a colourless, odourless solid crystallising from ethyl alcohol in small crystals, melting at 161° C. (cor.). As its physical properties as well as the chemical and physical properties of the new dye differ somewhat from those of the corresponding substances in the aniline blue reaction, it was necessary to modify the procedure in order to apply it to the case in hand.

12. *Tri* (2-Anilinobenzothiazolyl) Carbinol.

A mixture of 20 g. of phenylaminobenzothiazole and 10 g. of oxalic acid is heated to 170° on an oil bath in a flask equipped with a reflux air condenser and 10 g. more of oxalic acid is added in the course of 15 or 20 minutes. The temperature of the reaction mixture is then raised to 190° and kept there for two hours. It foams at first, probably due to decomposition of the acid, but at the end of the time remains in a state of quiet fusion. Pour into a beaker and allow to cool and solidify.

Grind up in a mortar and extract twice with hot water to remove the excess oxalic acid. The water acquires a slight purple colour and a purple mass remains. Dissolve in 150 cc. of boiling 96 per cent. ethyl alcohol and add 5 cc. of concentrated hydrochloric acid. The dye will not crystallise out on standing, and the solution is evaporated to a gummy paste to which is added 40 cc. of ethyl alcohol and a solution of 2.5 g. of sodium hydroxide in 20 cc. of ethyl alco-

hol. (The last two steps may be omitted as is obvious on consideration, but are recommended for purification.) Heat under a reflux condenser for one hour and allow to stand for 24 hours. A white precipitate settles out and the supernatant liquid is brown in colour.

Filter and neutralise to litmus with dilute (1:1) hydrochloric acid. The liquid becomes purple as the neutral point is approached, and a small amount of resinous material separates out. Filter this off and reject it.

(To be Continued.)

DEFINITION OF RELATIVITY.

By F. H. LORING.

Confining our attention to the purely relative characteristic of Relativity as enunciated by Einstein, this may be reduced to a comparatively simple statement. The Mechanics of which Newton was the chief exponent and chief contributor, simply made *space* and *time* instantaneously extensive, and they were tacitly understood to be independent of each other. For example, the *unit* of time was the same under all conditions, and therefore when the *second* was considered, its sameness was everywhere. There was no alteration of this unit from a relative point of view. However fast a person moved past a clock the fraction of time called a second was observed always as a second. Similarly, space had the same fixed universality, regardless of relative movement. Consequently a standard length, which is, as it were, a structural unit of space, was the same to an observer, either moving very slowly or moving exceedingly quickly past it. It will be seen that these ideas of the absoluteness of space and time implied that whatever units were chosen they would be the same under all conditions, and it could be said that space and time units were instantaneously extensive, for whenever they were considered they would be the same everywhere.

Einstein, however, practically said that when you introduce time and length into your calculations, you must consider them as *not* instantaneously extensive and their units *not* absolute; that is to say, these

units would *not* always be fixed and unchangeable. The reason for this is that it was found that certain phenomena led to conflicting and paradoxical results when attempts were made to analyse them in the orthodox manner. Einstein showed that they could be cleared up and co-ordinated by giving time and space units a changeableness in strict accordance with H. A. Lorentz's equation termed the *transformation equation*; because, in passing observationally from one moving body, or co-ordinate system, to another, this equation transformed the units of space and time. For example, an observer moving relatively to a clock would observe the "second" of time altered in the proportion 1 to $\sqrt{1-v^2/c^2}$, where c is the velocity of light and v is the velocity of the observer relative to the clock.

Similarly, relative lengths would have to be changed, that is to say, the unit of length would suffer a change (contraction) by relative observation, *i.e.*, one involving relative movement. This is, moreover, consistent because length can be defined so as to involve time. For instance, the length of a body can be indicated by the time taken to traverse it, the traversing movement being uniform.

The term *instantaneously extensive* is here introduced purposely to show that nothing can be instantaneous which involves appreciable distance; for, the quickest action, that of the propagation of light, is not instantaneous, but it takes a perceptible time for its propagation; hence its velocity (c) must enter into the equation if we take the quickest movement known as a criterion for movement; and when this constant (c) is used, the equation gives the answer agreeing with experiment in every case. Hence it will be seen that the term *relativity* signifies that all the factors suffer a relative adjustment as regards their fundamental units entering into the problem, and the velocity of light becomes a constant in the calculations. Mathematically co-variant equations are employed.

With small relative velocities there is no appreciable change, but as the relative velocities approach that of light the change becomes appreciable.

In applying this principle involving the Lorentz transformation, it will be seen that each phenomenon or event considered has its own time and length units by analysis (the local time thus becomes the real time)

so that they become, as it were, attached to the particular event. The reason for this may have partly arisen from the fact that in applying the calculus, which gives the right answer every time, one is introducing an analytical principle peculiar to the calculus itself. This is not new. It has long been known that the calculus afforded a powerful means of analysis. Einstein, however, went a step further—but it was a great step—in giving phenomena themselves the characteristics of the calculus, which meant that time and space must be considered relatively, in which case the units of time and space were no longer fixed, but suffered a change according to the amount of relative movement; and, as a consequence, each event had its own time and length.

Pressing this idea a stage further, the æther no longer becomes *instantaneously extensive*—if this term may be applied to the æther—but the æther is in consequence, as it were, attached to each event, so that the term *æther* is either a singular or a plural term, like *sheep*.

Thus it will be seen that space takes upon itself physico-mathematical characteristics and, when this conception is extended to gravity and the *principle of equivalence* introduced, this phenomenon falls into line and becomes an extension of the relativity idea. This accomplishment is classed under the head of *General Relativity*, while the earlier generalisation is referred to as the *Special Relativity*.

Minkowski brought time and space into union by making time the *fourth* dimension in his equations, so that space and time could not be separated since they became parts of a wider conception (space-time continuum, or four-fold manifold, or four-manifold to express it briefly), and this will be evident from the fact that one could not consider a block of space without implying by analysis *length, breadth and height*. These are inseparable constituents. When *time* is introduced by necessity, this becomes the *fourth* constituent, and on the same line of reasoning it becomes an inseparable constituent of the scheme. This means that an event has to be specified in all *four* dimensions completely to describe it analytically; thus *time* becomes the *fourth* dimension by implication.

The alternations in time and length involved in the theory of relativity seem to imply that they are conditioned by the

phenomena which they are used to describe.

The velocity of light in a vacuum is a constant in the equations. Moreover, this velocity (c) is supposed to be really constant regardless of any movement of the observer relative to the light source, *i.e.*, as measured by the moving observer. This is true of necessity, since by this system of analysis the units of space and time no longer remain constant when observed relatively, and this brings about the constancy of the velocity of light in a compensative way. Strange as this may seem, the interpretation of experimental results leads directly to this conclusion,* though there is no direct experimental evidence that the velocity of light in a vacuum would always be constant, whatever be the observer's motion.

The theory of relativity alters the conception of space and time in their relation to physical phenomena, and the analytical presentation of phenomena is in consequence altered. This theory, moreover, endows space with physical properties, and the physical properties of space become bound up with a mathematics of space which becomes particularly evident in the development of the theory to co-ordinate gravitational phenomena with mechanics in general as developed by this new theory.

* Accepting this constancy in the velocity of light, and reasoning back therefrom, we arrive at the conclusion that the relative view, as given above, is the true analytical interpretation of experimental knowledge of the kind involved in this discussion.

PROCEEDINGS AND NOTICES OF SOCIETIES.

ROYAL SOCIETY.

LIST OF PROBABLE PAPERS FOR READING
JUNE 29, 1922.

Sir J. J. Thomson, O.M., F.R.S.—On the Analysis by Positive Rays of the Heavier Constituents of the Atmosphere; of the Gases in a Vessel in which Radium Chloride had been stored for 14 years, and of the gases given off by deflagrated Metals.

Sir Robert Hadfield, F.R.S.—The Corrosion of Iron and Steel.

W. B. Dawson, D.Sc.—Harmonic Tidal Constants for Standard Ports of Reference in Canada. Communicated by Prof. F. D. Adams, F.R.S.

Prof. J. C. McLennan, F.R.S., and M. L. Clark.—On the Excitation of Characteristic X-rays from Light Elements.

J. C. Bramwell.—An Abnormal Relationship of the Electrical to the Mechanical Response in the Ventricles. Communicated by Prof. A. V. Hil, F.R.S.

T. S. P. Strangeways.—Observations on the Changes seen in Living Cells during Growth and Division. Communicated by Mr. W. B. Hardy, Sec. R.S.

SOCIETY OF GLASS TECHNOLOGY.

A meeting of the Society was held on Wednesday, June 21st, 1922, at 2.45 p.m.

A selection from the following papers was read and discussed:—

"The Composition of Lime suitable for various purposes in Glass Making," by Miss V. Dimpleby, B.Sc., and Prof. W. E. S. Turner, D.Sc.

"The Swelling of Sand on absorption of moisture, and its effect on Batch Mixing," by L. E. Norton and Prof. W. E. S. Turner, D.Sc.

"The Mixing of Batch," by Miss V. Dimpleby, B.Sc., A. W. Dickenson, and Prof. W. E. S. Turner, D.Sc.

"On the Devitrification caused upon the surface of Sheet Glass by heat," by Y. Amenomiya.

"Note on the effect of Alumina in retarding the Devitrification of Glass," by K. Kamita and Prof. W. E. S. Turner, D.Sc.

MINERALOGICAL SOCIETY.

A meeting of the Society was held on Tuesday, June 27th, at 5.30 p.m., when the following papers were read:—

Dr. W. F. P. McLintock and S. R. Ennos: The structure and composition of the Strathmore meteorite.

A. Brammall and H. F. Harwood: The Dartmoor Granite (part), its petrology and accessory minerals.

H. F. Collins: On some crystallised sulphates from the Province of Huelva, Spain.

Prof. H. Hilton: The graphical determination of the constants of a shear.

Prof. H. Hilton: A note on crystallographic notation.

A. F. Hallimond: Glauconite from Lewes.

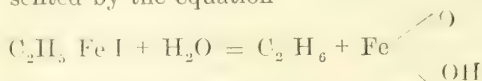
Dr. L. J. Spencer: Ninth list of new mineral names.

CHEMICAL NOTICES FROM FOREIGN SOURCES

FURTHER DETAILS OF THE SECOND CONGRESS OF INDUSTRIAL CHEMISTRY, to be held at Marseilles from July 2nd—8th, have now been published, and tickets can be had on application to the General Secretary, M. Jean Gérard, 49, Rue des Mathurins, Paris, VIII. Railway tickets, at prices which are reduced by 40 per cent., can be obtained by the members of the Congress who are travelling in parties of not less than 10. There will be a special boat down the Rhône from Lyons to Marseilles on Sunday, July 2nd, and a special train will run from Avignon to Marseilles. Full lists are given of the hotels and restaurants of Marseilles, with the charges for rooms and meals, and accommodation can now be booked. All the arrangements appear to have been excellently organised, and no pains have been spared to make the Congress a complete success.

PHOSPHORESCENT ZINC SULPHIDE A. A. Guinier. — Zinc sulphide is dimorphic, and both varieties are phosphorescent. The two varieties can easily be distinguished under the microscope. One, wurtzite, is composed by small octahedric crystals which act strongly upon polarised light. The other form, sphaterite, occurs in lamellæ, and has no such action. There is a very small difference in the densities of the two varieties. The phosphorescence only appears in presence of a trace of a heavy metal; with copper in the proportion of 1 to 10,000, both varieties emit a green light, but the duration of the luminosity is different. The phosphorescence of wurtzite is more persistent, but the decrease in the intensity of the light is very rapid. When placed in different regions of the spectrum the two varieties show no differences as regards the duration of the phosphorescence. In the infra-red they show the same phenomenon of extinction, preceded by a slight recrudescence of luminosity. Both varieties are exceedingly thermoluminescent and triboluminescent. The rays of radioactive compounds act on both forms, but blende appears to be rather more sensitive to them. X rays act like light in producing luminescence, but the two varieties do not show the characteristic difference in the respective durations of the phosphorescence when subjected to X rays. — (*Comptes Rendus*, CLXXIV., 1922, 1356).

PREPARATION OF ORGANO METALLIC COMPOUNDS. APPLICATION TO ETHYL IRON IODIDE André Job and René Reich. — The authors have observed that the organo zinc compounds act upon many anhydrous chlorides, and they conclude that probably organo metallic compounds exist in all series. They have tested this conclusion in the case of the compounds of iron. An ethereal solution of ferrous iodide FeI_2 can be prepared directly by shaking an excess of reduced iron with iodine in anhydrous ether, the solution being carefully kept out of contact with air. Then an ethereal solution of $\text{C}_2\text{H}_5\text{ZnI}$ is added, the whole being kept in an atmosphere of CO_2 . The solution is kept at the boiling point of ether for six hours, and is then taken up with water. Ethane is given off and ferrous hydrate is precipitated. The reaction which occurs is represented by the equation



and thus it appears that the $\text{C}_2\text{H}_5\text{FeI}$ is formed by a double decomposition $\text{C}_2\text{H}_5\text{ZnI} + \text{FeI}_2 = \text{C}_2\text{H}_5\text{FeI} + \text{ZnI}_2$. Ethyl iron iodide reacts with absolute alcohol to give ethane and ferrous iodo-ethylate. A corresponding ethyl iron chloride can be prepared by a similar method, and the authors are now applying the method to the phenyl series, and are also trying to prepare compounds of the type FeR_2 and $\text{FeR}'\text{R}''$. — (*Comptes Rendus*, CLXXIV., 1922, 1358).

GENERAL NOTES.

We have received from Messrs. Adam Hilger, Ltd., a pamphlet calling attention to their Hilger Quartz Spectrographs E1 and E3, together with an excellent photogravure of the Arc Spectra of Lead and Copper, taken with one of these instruments. The makers point out the value of these instruments, both in research and in certain classes of routine work in Industrial Laboratories, and give a list of well-known firms in whose works they are already installed.

In the House of Commons last week, Mr. Baldwin, in reply to Dr. Murray, said that he was aware that statements had been made that certain Organic Chemicals obtained from firms in this country had been

found impure and useless for experiment. He would suggest that research workers and others concerned should place themselves in direct communication with British manufacturers of fine chemicals, who would welcome any detailed criticism and co-operation in the development of the industry to their mutual advantage. He would also point out that the importation of these materials was not prohibited.

NOTICES OF BOOKS.

The Analysis of Non-Ferrous Alloys. by F. IBBOTSON and L. AITCHISON. Second edition: pp. VIII. + 246. London: Longmans, Green & Co., 1922. Price 12s. 6d. net.

Since the first edition of this work appeared in 1914, the importance of Non-Ferrous alloys has enormously increased, and in addition, the war has brought to the fore alloys previously unknown or very little used, *e.g.*, those of Aluminium.

In the present edition, the authors have included analytical methods for these, and have also considered recent improvements on older methods for the estimation of other metals alone, and in alloys such as brasses, bronzes, white metal, etc. It is perhaps a sign of the times that, wherever possible, electrolytic methods are now preferred, as they possess advantages of speed, cleanliness and accuracy. The authors describe these recent processes and the apparatus in adequate detail, and also give the most convenient precipitation and volumetric processes.

Numerous methods and modifications have been described in the scientific journals, and the authors have selected those of proved utility, including several of their own that have appeared from time to time in *The Chemical News*.

From his experience in the estimation of tin, the reviewer is convinced that the authors have included very satisfactory methods for determining this element, and doubtless the same applies to those given for other metals.

In view of the present interest in non-ferrous alloys this second edition will be especially welcomed by metallurgists, works' chemists, analysts, and others who are concerned in the use of these metals and their alloys.

J. G. F. D.

Coal Tar Colours in the Decorative Industries, by A. CLARKE, F.C.S. Pp. XIII. + 166. London: Constable & Co., Ltd., 1922. Price 6s.

The utility of coal-tar dyes in the decorative industries has not been fully realised, possibly because the earlier coal-tar dyes and their lakes were fugitive or "bled." This objection exists no longer, since it is possible to obtain dyes of excellent fastness, and perfectly insoluble lake pigments in almost all shades.

The author describes the classification and the nature of various types of dyes, and processes of dyeing. He then deals with the uses of the various colours used for dyeing or colouring leather, fur, wood, paper, etc.

In the last few years the manufacture of yarn and fabrics, of satisfactory wearing qualities, from paper, has assumed large proportions in Germany, as substitutes for textile materials, and should increase the demand for the various basic, direct, sulphur and vat dyes which can be used with this material.

Except that *quinoline* and *naphthalene* are wrongly spelt on page 103, this very readable book is free from errors and should commend itself to chemists and industrialists concerned with the decorative industries.

J. G. F. D.

Fluidity and Plasticity, by E. C. BINGHAM, Ph.D. Pp. XII. + 440 + 1 plate. New York: McGraw Hill Book Co., Inc. (London: 6 & 8, Bouverie St.) 1922. Price 20s.

Whilst the flow of electrical energy has been very fully studied and developed into an important science, our knowledge of the flow of *Matter* is meagre and remains largely empirical. Yet the flow of liquids is a subject of great importance to engineers.

Poiseuille, in 1842, was the first to demonstrate the simple nature of flow in capillaries, which is in contrast with the complex conditions of flow in wide tubes. He wished to understand the exact nature of the flow of blood, being interested in internal friction from the physiological point of view. He established what is now known as the Law of Poiseuille, which Prof. Bingham has amplified.

It is pointed out that plastic solids do not follow the law in their flow.

Among the chemists who have since investigated this subject, mention may be made of Graham, who carried out researches on Liquid Transpiration and Liquid Diffusion; Hellstadius; Pribram and Handl, and Thorpe and Redger, all of whom studied Specific Viscosity and its connection with Chemical Constitution.

Arrhenius, Ostwald and other physical chemists have paid some attention to the viscosity of aqueous solutions, but our knowledge of this subject has not made rapid progress. With physical chemists viscosity has remained in the background.

In the chapter on fluidity and chemical composition and constitution, it is shown that viscosity is closely dependent on the magnitude of the molecules making up the substance.

Various viscometers have been invented and used by different investigators, and the author describes several, but does not include those of Engler and Redwood. In recent years industrial and engineering chemists have devoted more attention to lubricants and the characteristics which should be possessed by the oils and greases employed in lubrication.

A good bibliography has been compiled; references are arranged alphabetically, thus also forming an authors' index. A separate Subject Index is also given. The only slip that has been noticed is on page 275, where benzene is accidentally quoted as a typical paraffin hydrocarbon, instead of hexane.

In his stimulating book, Prof. Bingham has lucidly correlated existing data on the phenomena of plasticity and viscous flow, and has indicated promising lines which may assist in elucidating obscure problems. The work should be well received by engineers and works' chemists, as well as by physicists and physical chemists.

J. G. F. D.

Industrial Nitrogen, by P. H. S. KEMPTON, B.Sc. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C. Price 2s. 6d. net.

An interesting little booklet dealing with the developments of the Nitrogen industry. The author, in his preface, lays stress upon the importance of the nitrogen industry during the late war. Upon this subject there can, of course, be no two opinions. Interest in the artificial production of nitrates commenced many years ago, and was

brought into considerable prominence by the late Sir William Crookes, in his book upon the wheat problem and the necessity for a commercial method of preparing nitrates.

The first few pages of the book deal with the elements of the subject and the natural and artificial fixation of nitrogen. In chapter 3 is given a detailed description, fully illustrated, of the various modern electrical processes that have been devised for the purpose, and another chapter is devoted to catalytic fixation.

The final chapter is given up to the imperial development of the subject, and stress is laid upon the enormous risk of dependence upon foreign sources for the compounds of nitrogen that are essential to the support of the nation—whether for food, the industries, or for protection. The book is well indexed and illustrated, and the author is to be congratulated upon having presented a very important subject in a concise and interesting form.

An Elementary Textbook of Metallurgy, by A. HUMBOLDT SEXTON, F.I.C., F.C.S. Sixth Edition. Revised and enlarged by C. O. Bannister, A.R.S.M., F.I.C., with 70 illustrations. Chas. Griffin & Co., Exeter Street, Strand. Price 8s. 6d. net.

The revisor, in a prefatory note, states that the above work was due for revision during the war, but its appearance had to be postponed. It has now been brought thoroughly up-to-date, and much new material has been introduced—details connected with the classification of pyrometers, manufacture of coke and producer gas, copper and lead smelting, the cyanide process of gold recovery, and other matters.

The book is well illustrated with diagrams and pictures of both ancient and modern apparatus.

Catalytic Action, by K. GEO. FALK. Harriman Research Laboratory, Roosevelt Hospital, New York. Book Department, Chemical Catalogue Co., 1, Madison Avenue, New York, U.S.A.

The author, in his book, has presented the subject of catalytic actions and their relation to chemical reactions in a very exhaustive manner.

In the first chapter is given a general review of the subject and the industrial

applications in which catalysis is involved. An interesting chapter is given on a chemical interpretation of life processes. The subject of enzymes, bacteria and other matters directly connected with the life process are discussed in detail.

The concluding chapter of the book is devoted to contact catalysis, in which the work of Langmuir and others is discussed. English readers will be grateful to the author and the publishers for having placed at their command a fund of authoritative information upon an increasingly important subject.

In a work dealing with the "Minor Forest Products of the Malay Peninsula," published by permission of the Federated Malay States Government, Dr. F. W. Foxworthy, Forest Research Officer, gives lists of poisonous and medicinal plants. Large numbers of the local plants, he writes, are used in native medicine, but only a few are recognised in pharmacy. A number of the species included in the list of poisonous plants, he writes, are used in native medicine, but only a few are recognised in pharmacy. A number of the species included in the list of poisonous plants are also of value for medicine, as it often happens that a poisonous plant contains an active principle which, under certain circumstances, may have beneficial physiological effects.

The list of the principal plants used locally for medicinal purposes contains no less than 343 names, and is taken mainly from an official bulletin entitled "Malay Drugs," published by Mr. H. N. Ridley, C.M.G., F.R.S., in 1906. The table gives the family to which each plant belongs, the botanical name, the common name (usually the name given by the Malays), the part used, and the complaints, &c., for which the extract from the plant is used. Occasionally some plant acquires prominence because of clearly fraudulent claims as to its curative properties. This seems to have been the case, some years since, with *Combretum sundaicum*, Miq., which was asserted to be a cure for the opium habit. A careful examination of the plant failed to reveal any just grounds for this claim.

Dr. Foxworthy makes the following comments in the introductory notes to this section of his work:—

Brucea sumatrana, Roxb. (Fam. Simarubaceæ).—Kosum is well known as a plant

useful in the treatment of dysentery. The fruit contains a useful alkaloid.

Taraktogenos kurzii, King (Fam. *Flacourtiaceæ*).—The seeds yield *Chaulmugra* oil, which is so useful in the treatment of leprosy. This species has not yet been found in the Peninsula, but occurs in Siam and Burma. Our species of *Taraktogenos* and of the related genus, *Hydnocarpus*, are worth investigating to see if they can be used in the same way.

Strychnos spp.—A number of species are found as climbers. None of our species are so valuable as *Strychnos Nux-vomica*; but several of them contain a good deal of active principle in the fruit, and two of them, *S. ovalifolia*, Wall., and *S. quadrangularis*, A. W. Hill, are used as constituents of a Sakai dart poison. Several of the species would probably repay chemical study. Fourteen species of this genus are recorded from the Peninsula.

Strophantus spp. — These are coarse shrubs or climbers, and contain a useful alkaloid, strophantin, in their sap. They seem not to be used as present.

Dr. Foxworthy's publication also contains references to tanning materials, oleo resins and wood oils, fruit or seed oils, essential oils, and dye plants and dye woods. It is the second part of a work dealing with the forest products of British Malaya, the first having been devoted to trees and timbers.

Volume 6, 1921, of the *Reports on the Progress of Applied Chemistry*, issued by the Society of Chemical Industry, is to hand, and contains many important papers on Fuels, Colouring Matters, Dyeing, &c., and an account of the recent developments in glass manufacture by Professor W. E. S. Turner, who also contributes an article on refractory materials. The article on photographic materials and processes is contributed by F. F. Renwick.

An important article upon Explosives is contributed by A. Marshall, of the Army Ordnance Department, Kirkee, India, commencing with a resume of American Explosives Law, and he also draws attention to the great dangers that have been incurred since the war in the storing and also in the destruction of explosives.

The preparation of Nitro-cellulose is given in detail, and the propellants used by the Germans and other nations during the war are described. Much detail is given of the serious poisoning properties possessed

by modern explosives, and the article concludes with a chapter dealing with their stability.

The subject of India-rubber is exhaustively treated by B. P. Porrett, M.Sc., F.I.C., and numerous references are given to the literature of this important subject.

The reports are well indexed, and the volume is an extremely valuable treatise on the latest developments in technical chemistry. The price of the book to members is 7s. 6d., and to non-members 12s. 6d., and it can be obtained from Messrs. W. Speight & Sons, Ltd., Fetter Lane, London, E.C.

We have also received a copy of the second volume of the *Annuaire Lambert*, issued by the Bureau d'Etudes Economiques Industrielles et Agricoles, 12, rue de Miromesnil, Paris.

It contains 300 tables in the 350 pages, and the price is 35 francs.

M. L. Aguilon, former Inspecteur-général des Mines, etc., contributes a preface, and points to the difficulties met in compiling such statistics as these by MM. Lambert, since all belligerent nations ceased to publish vital information during the war.

The *Annuaire* gives detailed statistics of the production and use of fertilisers and chemical products of service in agriculture for the period 1910-20. It is divided into two parts. The first part deals with the manufacture, consumption and transportation of these agricultural chemicals between the years stated.

The artificial nitrogenous fertilisers mentioned include Sodium Nitrate, Ammonium Sulphate, Calcium Nitrate and Cyanamide. The phosphatic fertilisers include Calcium Phosphate, Superphosphate and Slags. There is also a section dealing with the production of potassium salts in Alsace and Stassfurt, and a brief summary of the potash industry in America during the war.

The second part gives statistical matter relating to agricultural chemicals in the principal countries of Europe and the United States. The alteration of frontiers and the formation of new States consequent upon the war has complicated the authors' task. For instance, in the tables indicating the distribution of Calcium Phosphate for the years 1910-18, Alsace, Lorraine and Upper Silesia are all included under Germany; and Czecho-Slovakia is included under Austria. In the statistics for 1919-

20, Alsace and Lorraine are included under France; Upper Silesia under Germany; Poland and Czecho-Slovakia appear, and the figures for the two States are combined—a procedure which cannot be continued longer.

This "Annuaire" will be of service as a work of reference for economists, industrialists, and others concerned with the scientific development of agriculture.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 15562 Ashcroft, E. A. Treatment of sulphide ores. June 2.
- 15597 Bea-ley, W. H. Refining of copper oxide. June 2.
- 15065 Bloxam, A. G. Manufacture of black azo dye tuffs. May 29.
- 15342 Domiens, A. A. Extracting sulphur from gases containing sulphuretted hydrogen. May 31.
- 15586 Galbraith, W. L. Reduction of organic compounds. June 2.
- 15362 Imray, O. Y.—Manufacture of 2:2 diamino anthraquinone. May 31.

Specifications Published This Week.

- 159164—Condensite Co.—Production of phenol-aldehyde condensation products.
- 151156—New Jersey Zinc Co.—Manufacture of zinc oxide.
- 179982 Delarozziere, F. F.—Manufacture of sodium ferro-cyanide.
- 180027—Hanco, T.—Process for the production of fertilisers containing phosphoric acid and potash.
- 190110—Kelly, A.—Process for the production of sodium pentaborate direct from boric ores.
- 180175—Courtaulds, Ltd.—Manufacture of carbon bisulphide.

Abstract Published This Week

Crystallizing.—Patent No. 17562. An improved apparatus for crystallizing and separating the salts contained in mixed solutions has been invented by Mr. T. G. Tullock, of Bank Buildings, King Street, St. James, London.

The solution is evaporated by being run down a sloping table, and the salts separate on the table in the order of their solubilities, the least soluble being deposited first.

The table which may be cambered, has projecting edges and transverse inclined baffles, and intermediate spreading baffles. The table may be mounted on trunnions so as to be turned to discharge the salts, and may be combined with other tables in triangular or other form so that, on being turned, another table surface is brought into position. The table may be heated by electric resistance extending along it or by other means, and may be covered and the watervapour evolved be drawn off and condensed. Glass covers may be used and the heat of the sun used to effect evaporation.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXIV., No. 3247

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

ANNUAL CONFERENCE, 1922.

ADDRESS BY THE PRESIDENT (MR. J. PALEY YORKE).

(Continued from Last Week.)

RESEARCH AND CONTACT WITH INDUSTRY.

The part-time teacher also helps to bring the full-time staff into necessary contact with the practical world. We have always laid it down as an essential that teachers of technology should have opportunity for research work and for contact with industry. The opportunity is scant. Suggestions have been made that technical teachers should be allowed to take up research work for firms. We recognise the difficulties and we recognise the possibilities of abuse. At the same time the mutual advantage which would accrue to industry and education would be so great that some scheme might easily be devised whereby the directors of industry could submit the research work to the Local Education Authority and through them to the scientific and technical staffs of the various Technical Institutions in the area. One can see, of course, that all research problems would not arrive that way because of the publicity involved; but some useful work could be done.

Some authorities are providing for six months' leave of absence every six years to enable technical teachers to make direct contact with industrial development either by entering work or by travel. This is an excellent scheme, and should be productive of much good, provided that it be not so hampered with regulations that no man can afford to take the fullest advantage of the offer.

LEARNED INSTITUTIONS AND EXAMINATIONS.

It is not many years since we welcomed the abolition of the Board of Education's system of external examinations in science and art. That system played a tremendously important part in the development of our work, but it was felt that it had

played its allotted part and that the time had arrived when it might be abandoned with advantage, lest it should exercise too much restriction on educational expansion. That must always be the tendency of the more or less rigid syllabus.

When the Board of Education's system was abandoned many of us felt very anxious lest other schemes of a local character and with a narrower view should spring up in its place. Our anxiety was not caused by any feeling of resentment that our work should be tested, but by the fear that the method of testing might be such that courses of instruction would become cramped and rigid.

We do not disguise from ourselves the fact that the bulk of students do like to have some kind of an objective—an objective that is to say which shall be a certificate that some standard of attainment has been reached. Superior people may be scornful of the desire—but it is a very human desire after all, and there can be no serious objection to it provided that it does not involve the setting up of a cast-iron system and the moulding of all students to one pattern as though they had been turned out of an automatic machine.

Therefore we look with considerable interest upon the scheme which the Institution of Mechanical Engineers, in conjunction with the Board of Education, has just put into operation.

This is an "internal" scheme, in which the quality of a student shall be judged not only by examinations, but by the record of his work and the reports of his teacher. The examination papers will be framed by the teacher and approved or altered by an "assessor" appointed by the Institution of Mechanical Engineers. Only the Technical Institutions which have been recognised or approved by the Board of Education as being efficient for this purpose may participate in the scheme, and in this way every student who presents himself will have passed through a course of instruction which meets with the approval of the Board.

The merits of the scheme lie in the following facts: (1) That the students' whole work is judged by one who has had the opportunity of watching it closely; (2) that the appointment of an assessor by the Institution of Mechanical Engineers prevents any unfair judgments arising out of conscious or unconscious bias on the part of

the teacher and assures a reasonable equality of standard; (3) that greater freedom of educational development is permitted when all students are not working to one cast-iron syllabus.

The scheme seems to be promising, if only it does not become too hide-bound and too heavily tied up in red tape regulations. We shall watch it with interest, but our interest will speedily evaporate if it should develop merely into an examination system. It is essential in my opinion that it should encourage students to make progress in their profession, and to that end it should be associated in some way or other with the means of attaining corporate membership of the professional Institutions—in this case the Institution of Mechanical Engineers.

GRANTS AND SCHOLARSHIPS.

Amongst the things to which attention will be drawn at the conference is the proposed reduction of grants for scientific research and the reduction of the number of national scholarships for Higher Education. These things are noted not only because such reductions gravely imperil scientific and industrial development, but also because the percentage reduction in the estimates for these items is much greater than that for corresponding items in other branches of educational work.

It would almost seem that there is being carried out a definite policy for the starvation of higher work and for the removal of many rungs of that educational ladder about which so much is said whenever our education system is being appraised by our administrators.

THE LABOUR PARTY AND TECHNICAL EDUCATION.

We welcome the interest which the Labour Party is taking in educational development, and particularly do we welcome the fact that Technical Education is no longer regarded by that Party with suspicion and distrust. That distrust no doubt arose from the mistaken idea that Technical Institutions were going to teach trades and provide employers with cheap labour; and that in some way or another they represented a form of subsidy to capital at the expense of labour. They are now regarded in a different light. It is seen instead that they provide a means of higher education within the reach and within the

means of most people, and in that light they are being welcomed.

OUR CHIEF WORKERS.

It is with great pleasure and satisfaction that I am able to report that the Council of this Association has been able to recommend the appointment of a stipendiary Secretary to assist the Honorary Secretary to carry out the ever-increasing labours of our Association. We have been well served by our voluntary workers in the past, but our work has grown so steadily, and latterly so rapidly, that we were imposing upon them an intolerable and impossible burden. In particular, of course, did we burden our Hon. Secretary, and we are tremendously grateful to Mr. Sirman for the splendid way in which he has responded to the calls made upon him. We are also very glad that he has consented to accept nomination for the Hon. Secretaryship for at least another year, and we look forward to some valuable work being done with the aid of the gentleman whom the Council has nominated for the stipendiary Secretaryship.

I would also like to offer congratulations to the Editor of our Journal (*The Technical Journal*), Mr. F. E. Drury, for his successful efforts. He had a difficult task in following our Mr. Abbott—I think that we may use the possessive pronoun—and his success is therefore all the greater.

In Mr. Riley we have an Hon. Treasurer of unsurpassable merit. I am afraid that his work is so excellent and so faultless that it does not receive the publicity which it deserves, nor do we always express to him the gratitude that we feel.

CONCLUSION.

The first object of our Association as set forth in our Rules and Constitution, is to promote the interests of Technical Education generally. In that we are sincere, and our record of activity during the eighteen years of our existence is proof of that sincerity. The fact that we would also seek to safeguard the professional interests of our members does not detract from that sincerity. I can say with certainty that our organisation has been welcomed by the Board of Education and by the leading Education Authorities as the channel through which they can obtain the opinions of Technical Teachers—who put into practice the educational schemes—who know by

experience the weaknesses and strength of the various parts and who know what Technical Education does and can do.

The proper use of knowledge is in man's keeping, and it is his plain duty to use it for the benefit of mankind.

Knowledge was never intended to be used merely as a form of mental adornment or for the external equipment of what might be called the mental fop. Much of it has been used for that purpose, and there has been too much mental snobbery in the ranks of those who should have shown to all the world that education gives to man that sweet reasonableness, balance, judgment, and kindly indulgence, which go to make the relationship between one man and another more nearly in accord with that great commandment, "Love one another."

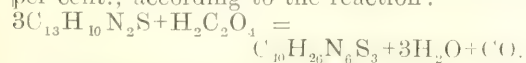
Our Association stands for the proper use of knowledge—not merely in the materialistic sense, but with a full sense of the responsibilities of civilisation. We may deplore many of the products of civilisation, but we have some responsibility for them, and it is our plain duty to so train the mind of man that he may be able to acquire that joy of living which can only spring from understanding satisfaction in his work, from the feeling that he is definitely creating, definitely achieving something worthy of achievement, and something in which he can take pride; and from the ability to lead a fuller life in his hours of rest and recreation.

DEHYDROTHIOTOLUIDIN: ITS ISOMERS, HOMOLOGUES, ANALOGUES, AND DERIVATIVES.

By MARTIN MEYER, B.Sc., M.A.
NEW YORK CITY.

(Continued from Last Week).

The filtrate is treated with double its volume of water and allowed to stand one hour before filtering. The precipitate appears to be a mixture of the leuco base and colour base, and its dry weight is 19 g. or 90 per cent., according to the reaction:



The melting point is not sharp, but is below 100°.

13. *D*-benzothiazolyl-Fuchsone-Benzothiazolylimine.

The leuco base is then oxidized to the dye with lead peroxide by the method of Gat-

terman⁵⁰ using a suspension of the finely powdered material as it is insoluble. Heat and shake the solution for 15 minutes, and filter after adding the sodium sulphate according to his direction. Extract the precipitate with hot ethyl alcohol and precipitate with water.

The new dye has a deep purple colour but very poor tinctorial value, dyeing silk only a pale lavender from alcohol solution as it is insoluble in water. This is probably due to the fact that apparently the hydrochloride is unstable and is hydrolyzed by water, for a qualitative analysis showed C, H, N, and S, but no chlorine. It was then analyzed for nitrogen according to the method of Fisher⁵¹ as were the other analyses.

Calculated for $C_{40}H_{26}N_6S_3$	N =	12.24%
Found	N =	{ 12.03%
		{ 12.12%

14. *Sulphonation of the Dye.*

It was thought that the poor tinctorial value of the new substance might be due in part to its neutrality and extreme insolubility, so an attempt was made to sulphonate it with 15 per cent. fuming sulphuric acid. The sulphonation mixture was diluted with water, neutralised with barium hydroxide, and the precipitated barium sulphate was filtered off. The resultant yellow solution was concentrated and allowed to crystallise, depositing pale yellow plates, but as the hue of the dye appeared to be destroyed in the process, no further work was done on it.

15. *Nitro-tolyl Benzothiazole.*

In connection with the second and third purposes of this investigation, it was considered desirable to prepare some of the derivatives of the paratolyl benzothiazole, especially the nitro ones, because the nitro group frequently functions as an odorphore, as in the synthetic musks; and the amino derivatives, which would be isomeric with the valuable dehydrothiotoluidin which has already been mentioned a number of times.

The nitration of paratolyl benzothiazole may be accomplished with fuming nitric acid or a 1:1, by volume, mixture of concentrated sulphuric and nitric acids. The best procedure for moderate quantities follows:

50. Gatterman, *Practical Methods of Org. Chem.*

51. Fisher, *Lab. Man. of Org. Chem.*

In a small flask dissolve 2.5 g. of paratolylbenzothiazole in 10 cc. of concentrated sulphuric acid, and add 10 cc. concentrated nitric acid. The solution becomes warm at once, nitrogen tetroxide is evolved, and the colour changes from yellow to reddish-brown. Heat on a water bath for one hour. Let cool and pour into 100 cc. of water. A bright orange-yellow precipitate settles out, which on drying weighs 3 g. The coloured impurities may be removed by warming on a water-bath with about 50-80 cc. of ethyl alcohol, and the residue can then be dissolved in 50 cc. of hot toluene, which on cooling deposits the mono-nitro derivative in pale cream-coloured, odourless crystals, M.P. 219.5° C. (cor.).

Calculated for $C_{14}H_{10}O_2N_2S$ N = 10.38%
 Found N = $\left\{ \begin{array}{l} 10.51\% \\ 10.56\% \end{array} \right.$

The nitration proceeds smoothly and quantitative yields according to the equation
 $C_{14}H_{11}NS + HNO_3 = C_{14}H_{10}O_2N_2S + H_2O$
 may be obtained from any weights. Toluene is a remarkably good solvent for purification, as the difference in solubility with temperature is strikingly great.

16. Aminotolyl Benzothiazole.

The nitro derivative was then reduced, using zinc or tin and hydrochloric acid according to the method of Gatterman. The amine forms an addition product with the

metallic salts, from which it is a little difficult to remove the metal, and may be crystallised from ethyl alcohol, amyl alcohol, or toluene, none of which are good solvents as the substance is quite insoluble, but the last is the best of the three, and yields the base in small brown crystals, which are much lighter in colour on purverisation and melt at 229° C. (cor.). Amyl alcohol and toluene solutions exhibit a bluish-green fluorescence which is characteristic of most of the benzothiazoles.

Calculated for $C_{11}H_{12}N_2S$ N = 11.67%
 Found N = $\left\{ \begin{array}{l} 11.80\% \\ 11.90\% \end{array} \right.$

17. Azo Dyes from Amino Paratolyl Benzothiazole.

Amino paratolyl benzothiazole is not a dye, but can be diazotized on the fibre and coupled with the usual materials, and yields a series of direct cotton colours. This was done according to the method which will be described later, with the results noted in the table. With the amines as couplers, the developer was made up as a 2 per cent. solution by weight, using sufficient glacial acetic acid to dissolve them, and after the cloth was immersed, the bath was neutralised with 10 per cent. NaOH, thus precipitating the dye out in the fibres of the material. Other acids do not appear to give satisfactory results.

TABLE.

Base diazotized and coupled with:			Colour.	Depth.
Coupler.				
1.	Phenol		Yellow	Good
2.	Aniline		"	Fair
3.	<i>p</i> -Cresol		Salmon orange	Good
4.	Para-toluidin		Yellow	Fair
5.	<i>B</i> -Naphthol		Pink	Good
6.	Alpha-naphthylamine		Brown	"
7.	<i>B</i> -naphthylamine		Orange	"
8.	Resorcinol		Yellow-brown	"
9.	Benzoylene urea		Orange-pink	Poor
10.	(2) diazotized	+resorcinol	Yellow-brown	Good
11.	(2) "	+ <i>B</i> naphthol	Orange-pink	"
12.	(2) "	+ <i>p</i> -toluidin	Yellow	"
13.	(12) "	+ <i>B</i> naphthol	Orange red	"
14.	(6) "	+anilin	Brown	"
15.	(6) "	+phenol	"	"
16.	(7) "	+phenol	Orange	"
17.	(7) "	+aniline	Orange red	"
18.	base "	+phenylaminoben-		
		zothiazole	Yellow-brown	Poor
19.	" "	+ammonia	Yellow	"
20.	(6) "	+ <i>B</i> naphthol	Purple	Good
21.	(7) "	+ <i>B</i> naphthol	Orange	"
22.	(6) "	+ <i>p</i> cresol	Brown	"

These colours are all as fast to light, soap, bleaching, etc., as the corresponding azo colours from dehydrothiotoluidin, and the tinctorial value in general appears to be much better, particularly of the browns, where it is really quite remarkable. To put it colloquially, "a little will go a long way." The specimens were all dyed from a 1 per cent. solution of the amine in the presence of sodium chloride according to the method given later, dried, and steam pressed.

The bis-diazo compounds are better than the primary diazo ones, both from a consideration of variety, and of depth of colour, particularly those of alpha and beta-naphthylamines from which, as well as those given, a good series of browns may be obtained. It would be interesting and illuminating to determine if a series of greens could be obtained from this base by diazotizing and coupling with dioxynaphthalene disulphonic acids, as in the case of dehydrothiotoluidin,⁶⁷ but unfortunately, the last two reagents were not available, and all other attempts to prepare a green or blue failed, with the exception of the one purple found in the chart, which, however, it is interesting to note, begins to approach these in structure.

18. *Para* (2 Benzothiazolyl) Benzoic Acid.

Paratolyl benzothiazole contains a methyl group which it should be possible to oxidize to the corresponding carboxyl group by methods analogous to other side chain oxidations. This was first attempted by means of potassium permanganate in neutral solution in the presence of magnesium sulphate according to Fisher. The permanganate was reduced, but the final yield of the expected acid from 5 g. of the thiazole was so small that it could only be crystallised once, and the amount was too small to proceed further with. The substance obtained was yellow white in colour and appeared to decompose, but did not melt up to 270°.

A second experiment was performed using permanganate in alkaline solution, according to the method of Bigelow,⁶⁸ and while the yield was larger than in the first case, 0.5 g. from 5 g. sample, it could not be purified sufficiently for analysis. The

substance resembled that in the first experiment in every way, crystallising in microscopic white needles from alcohol, which darkened but did not melt up to 270° C.

19. *Primuline*azo-Benzoylene Urea.

It has been shown⁶⁹ that 1:3 dioxiquinolin is particularly suited, in combination with primuline diazotized on the fibre according to the process invented by A. H. Green, to give acid, light, and wash fast orange colours on cotton. The procedure is given in the patent, for example: one requires for a 2 per cent. primulin developed colour, a mixture of 1 per cent. 1:3 dioxiquinolin as the sodium salt, and 1.5 per cent. sodium carbonate in which the material is immersed after coming from the diazotizing bath. Dioxiquinolin gives a clear orange colour of greater acid-, base-, and wash-fastness than the corresponding phenol or resorcin developed colours. It was therefore thought that benzoylene urea which resembles dioxiquinolin closely, would also couple to give a dye exhibiting these valuable properties.

The procedure used in dyeing was a modification of that described in the *Badische Co. Pocket Guide* (p. 101), and as practical methods of this kind are not as readily accessible as might be thought at first, a brief summary is given.

(a) Before dyeing, boil the cotton in a water solution of sodium carbonate and wash with water.

(b) Enter the cotton into the dye bath (2 per cent. primulin) and work at a boil for 1½ hours, adding 5-30 lbs. of crystalline Glauber's salt or 2½ to 10 lbs. of sodium chloride for 100 lbs. of cotton.

(c) Dye cotton as just given and treat for one-half hour in a fresh, cold diazotizing bath, using 3 lbs. of sodium nitrite and 8½ lbs. of concentrated hydrochloric acid per 100 lbs. of cotton, keeping the temperature below 50° F. by the addition of ice. Add the sodium nitrite to the acid, not *vice versa*. (This is an unnecessary precaution for laboratory procedure.) Rinse once in cold acidified water and enter into the developer for one hour.

(d) A typical developer bath (for Ingram red) consists of a 1 per cent. solution of beta naphthol dissolved in warm water by means of an equal weight of sodium hydroxide.

For small amounts of material a 100 cc.

67. Clève, *Berichte*, 21, 3271 (1888); *D. R. P.* 69265.

Clève, *Bull. Soc. Chim.*, 26, 444 (1876).

68. Bigelow, *J. A. C. S.*, Vol. 41, 1559 (1919).

69. *Bad. An. and So. F.*, *D. R. P.*, 210, 453; Friedländer, 9-411.

working modification of this gives very good results. The diazotizing bath consists of 17 cc. of concentrated hydrochloric acid, 6 g. of sodium nitrite, and 200 cc. of water. The primulin in this experiment was a museum specimen furnished by the Casella Co., the benzoylene urea was a portion of that pre-

pared by Scatchard,⁷⁰ and for purposes of comparison ingrain red (primulin-azo-beta-naphthol) was used. Benzoylene urea as a developer gave a yellow brown colour that comes out much more slowly than the red.

Tests for fastness were made with these results:

Test.	B.U. Yellow.	Ingrain Red.
Boiling with 5% HCl	Fast	Fast
Boiling with 10% NaOH	Darkens slightly	Bleeds out
Bleaching powder	Not bleached	Not bleached
Direct sunlight—two weeks	Fades slightly more than red	
Soap solution, boiling	Fast	Fast

The tinctorial value of the new dye is just as good as ingrain red, and it appears to be of about the same order of fastness as the latter, except to prolonged exposure to light, but this is more than counter-balanced by its greater fastness to alkali.

PART B—DEHYDROTHIOTOLUIDIN.

This compound is prepared commercially, directly from paratoluidin and sulphur, and the methods are at variance on two principal points, the manner of conducting the fusion, which is either by a mixture of only the two substances in molecular quantities, or by the addition of a diluent such as naphthalene or an excess of paratoluidin, and the method of purification. In any event, much primulin and other substances are formed simultaneously, and their formation is greater in the presence of an excess of sulphur, and since dehydrothiotoluidin is the more valuable of the two, this is to be avoided. Of the patents already mentioned "the basic ones are those of Kalle and Co., of Biebirch am Rhein (a duplicate of the original one mentioned earlier with some changes), and of Leopold Casella and Co. Three methods of separation of the mixed bases which form the melt are available. The Casella patent appears to do so by a

difference in the basicity of the two compounds, claiming that dehydrothiotoluidin is more soluble in a 30 per cent. by weight solution of sulphuric acid, while the Kalle patent effects this result by taking advantage of the fact that the ammonium salt of dehydrothiotoluidin sulphonic acid is less soluble in water than the corresponding derivative of primulin. The third method consists in distilling the melt in vacuo by which only dehydrothiotoluidin comes over, but from a commercial standpoint this method is unsatisfactory, and although it is being used at present, if there was a way of avoiding it, it would be abandoned due to the difficulties of the process in the plant.

Preliminary experiments showed that, in spite of the number of patents and the volume of literature on this subject, practical directions for the synthesis were noticeably lacking, and a critical study of all the methods was made with a view to supplying this deficiency from a laboratory standpoint at least.

1. The Casella Method.

The melt was prepared according to the patent directions in each case, substituting grams for "parts" in the wording of the patent. After heating, the fusion mixture was repeatedly extracted with 500 cc. portions of 30 per cent., by weight, sulphuric acid until nothing further was dissolved. The liquid extract was then drowned in water, or later diluted only a little more, and neutralised while warm with sodium hydroxide, which precipitates the mixed bases in a form which is more readily filtrable. The first factor investigated was the effect of length of heating time on the

44. Dahl & Co., *D. R. P.*, 35790; Friedländer, 1, 536.
Kalle & Co., *D. R. P.*, 92011; Friedländer, 4, 824.
Bayer & Co., *D. R. P.*, 65402; Friedländer, 3, 752.
Casella & Co., *D. R. P.*, 53938; Friedländer, 2, 293.
Picke, Lange & Co., *D. R. P.*, 52509; Friedländer, 2, 292.
Höchstes Farb- u. Chem. Co., *D. R. P.*, 104 230; *Centralblatt*, 1899 (2) 950.

70. Bogert and Scatchard, *J. A. C. S.*, 41, 2052 (1919).

weight of the sulphuric acid extract, and it was found that there was very little advantage in keeping the melt in fusion longer than four hours. In extracting the melt it is desirable to keep the temperature below 100° C. on a water bath, when two extractions will remove all of the soluble material with a minimum of impurities. The yield at this point, however, after a number of experiments, was never better than 33 per cent. of the theoretical amount of the substance from the equation:

$$2C_7H_7NH_2 + 4S = C_{11}H_{12}N_2S + 3H_2S,$$

assuming the extract, for purposes of calculation only, to be pure dehydrothiitoluidin.

It was then attempted to purify the product by recrystallisation from solvents. The melting point of the crude extract varies from 165°-175° C. (uncor.). A single crystallisation of this from alcohol will bring the melting point up to 185°, and if this is then dissolved in the least amount of hot acetone, refluxed with boneblack for one-half hour, filtered, and allowed to crystallise, a pale yellow product in small needle crystals melting at 192° C. (cor.) is obtained.

There are two difficulties in this method. In the first place the losses by the two crystallisations are so great that it is not a satisfactory method of preparation even from a laboratory standpoint. The first one from ethyl alcohol must be done rapidly from the hot solution as it colours up and becomes tarry and resinous quickly, and purification by crystallisation is then impossible, so that of all of the extract cannot be utilised. In the second place the composition of the sulphuric acid extract seems to be decidedly variable, depending on the physical conditions during the extraction, so that there is frequently some difficulty in getting the first solution to crystallise at all, as dehydrothiitoluidin does not do so in the presence of large amounts of the higher preminelines. It was first thought that this difficulty was due to the presence and oxidation of paratoluidin which can be shown to be present in considerable quantities even after eight hours' heating. (If the sulphuric acid extract, instead of being neutralised with sodium hydroxide as in the later experiments, is diluted with ten times its volume of water, the bases are completely precipitated and the filtrate will deposit nothing on further dilution, but if it is then neutralised with sodium hydroxide, a copious, flocculent, white precipitate is formed which can readily be shown to be paratoluidin). The idea then presented it-

self of freeing the mixed bases obtained from the sulphuric acid from paratoluidin by steam distillation before attempting to purify the dehydrothiitoluidin by crystallisation, but it was found that this did not solve the problem, as the paratoluidin apparently was not responsible for the difficulty. It was subsequently found in the literature that the same suggestion was made by Jacobson⁷¹ in one of the earlier articles, and upon experiment he reached the same conclusion. It was also found by experiment later that pure dehydrothiitoluidin can readily be separated from moderate amounts of paratoluidin by crystallisation.

If the second crystallisation is made from cold acetone and the boneblack omitted, the substance crystallising out is dark brown and gummy, does not melt up to 220°, and cannot thereafter be obtained as light in colour as the preceding product, exhibiting, even after a prolonged boneblack-ing, an orange-yellow colour and slightly lower melting point.

71. Jacobson, *Berichte*, 22, 330 (1889).

(To be Continued.)

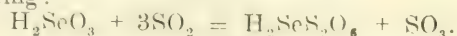
THE SELENIUM-SULPHUR COMPOUNDS.

By JOHN MISSENDEN, B.Sc.

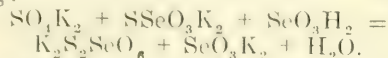
Both Ditte and Gerichten have described a number of substances that they believed to be compounds of selenium and sulphur, but which were later proved by Bettendorf in the *Annalen der Physik und Chemie* and by Divers in the *Chemical News* (Vol. LI., p. 24) to be mixtures of the two elements, and not compounds. Some diversity of opinion has been held over the actual group formation of the few known selenium-sulphur compounds, but experiment has shown that these formations are fixed and definite.

The first of the category is the simple composition of selenium with sulphur and oxygen, a rich green substance being formed. This is *selenosulphur trioxide*, $SeSO_3$, and it is most easily obtained by dissolving pure selenium in concentrated sulphuric acid, although another method is to dissolve it in sulphur trioxide, providing the latter be very cool and newly distilled (Roscoe). Upon heating strongly, selenosulphur trioxide decomposes without fusion into sulphur dioxide, selenium dioxide, and selenium.

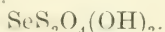
It is due to Schulze that the next compound, *selenotriithionic acid*, $\text{H}_2\text{SeS}_2\text{O}_6$, is obtainable in the free state. It is produced when selenious acid, H_2SeO_3 , is brought into contact with a considerable excess of sulphur dioxide, the reaction being:



A potassium salt of this acid may be obtained when an excess of normal potassium sulphate and a concentrated solution of selenious acid be treated with a solution of potassium selenosulphate, the reaction being:



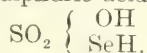
The correct group formation of selenotriithionic acid is:



Schulze also discovered that when sulphur dioxide is kept in the presence of an excess of selenious acid, another acid compound is obtained, having the formula $\text{H}_2\text{SSe}_2\text{O}_8$.

Sulphoselenoxytetrachloride, $\text{Cl}_2\text{SO}_2(\text{OSeCl})_2$, is little known, but may be produced by the action of selenium tetrachloride upon chlorosulphonic acid, HClSO_3 (sulphuryl-hydroxychloride). It takes the form of a conglomeration of white crystals which melt at 165.8°C ., the resultant liquid boiling at 183.5°C .

Selenosulphuric acid, H_2SeSO_3 , has never been known in a free state, and in this respect, as well as in others, it is analogous to thiosulphuric acid. It is responsible for a series of selenosulphates which are isomorphous with the thiosulphates. These selenosulphates, too, are readily decomposed by all the acids with the production of red selenium. The potassium salt of selenosulphuric acid is obtained by treating a solution of potassium selenide with one of sulphurous acid; while it may also be obtained by dissolving selenium in a solution of normal potassium sulphite in the presence of selenotriithionic acid. The group formation of selenosulphuric acid is:



A NEW METHOD FOR THE DETERMINATION OF BISULPHITES.

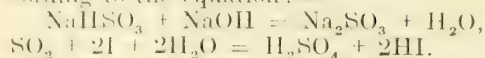
Fr. Kühn, B.Sc., Copenhagen.

[Reprinted from the "Journal of the Society of Leather Trades' Chemists," June, 1922, Vol. 6, No. 6, Page 199.]

There are two well-known methods for the estimation of bisulphites:

(1) A technical alkalimetric method ac-

cording to the equation:—

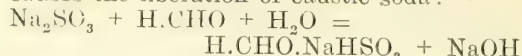


This method alone does not differentiate between normal sulphite and bisulphite, but by combining this method with the alkalimetric method it is possible to estimate both sulphites and bisulphites.

The author, however, prefers the following method:—2 gms. of the bisulphite are using phenol phthalein as indicator.

This method, however, suffers from the disadvantage that bisulphate is estimated as bisulphite.

(2) *Iodometric Method*.—In acid solution the following reaction takes place:—dissolved in water and titrated with normal NaOH (a cc.) This titration is a measure of the total acidity. 10 cc. of neutral 40 per cent. HCHO solution are added, which causes the liberation of caustic soda:—



and the formation of the well-known sodium bisulphite-formaldehyde compound. The liberated NaOH is then titrated with normal HCl (b cc.). 1 cc. N/1 HCl $\equiv$ 0.064 gm. SO_2 .

The following results are possible:—

(1) $a=b$.—If any impurities are present, they are neutral such as sodium sulphate.

(2) $a>b$.—Acid impurities are present. The difference $a-b$ is calculated as bisulphate (NaHSO_4).

(3) $b>a$.—Normal sulphite is present. The difference $b-a$ is calculated as normal sulphite (Na_2SO_3).

Results obtained by:—

Iodometric Method .. 57.9 per cent. SO_2 .
This Method 58.2 per cent. SO_2
consisting of 86.3 per cent.
 NaHSO_3 and 10.1 per cent. Na_2SO_3 .

CORRESPONDENCE.

TO THE EDITOR OF "THE CHEMICAL NEWS."

DEAR SIR,—As I have ample means of exhaustive research, I beg that you will be so kind as to communicate to your readers that should any point arise connected with new fields of discovery or with discovered matter that requires verification, it will be a great pleasure to me if they will send me their problems through your good offices, and I will examine them and let them have a note upon my results.

My object in doing this is to further the cause of Science in the service of humanity; and, as my time is almost wholly devoted to such studies, especially with

regard to the rare earth metals, such an opportunity of helping my fellow-experimenters would be both gratifying to myself and possibly beneficial to them.

Yours, &c.,

JOHN MISSENDEN, B.Sc.

7, Beach Road, Lowestoft.

22nd June, 1922.

THE COST OF SCIENTIFIC BOOKS.

TO THE EDITOR OF "THE CHEMICAL NEWS."

SIR, — I am one of those who endeavour to keep abreast of modern developments in chemical and physical science, and who value your Journal as a means to that end. Frequently I read a notice in your columns of some scientific book which inspires me with a desire to increase my knowledge by studying it, but not seldom is this desire frustrated by the high price asked for the book in question. I am convinced that the present high prices demanded for their wares by many publishers of scientific books, on the one hand, are acting as a deterrent to the advance of scientific knowledge, and, on the other, are totally unwarranted. The costs of production are certainly much higher than before the war, but they are by no means so high as some folk would have us believe. I can instance the case of my book, *Alchemy: Ancient and Modern*, of which a second edition* has just been published by Messrs. Wm. Rider & Sons, in refutation of those who assert that the present high prices are necessary. Without conceit, since for these things Messrs. Rider & Sons, and not myself, are responsible, I can say that the printing, paper, and binding of this book are excellent. It contains sixteen full-page lithographed (not half-tone) plates, and yet the publishers can afford to sell the book at 7s. 6d. Many firms are asking as much as 20s. for scientific books, and even ordinary text-books, which—whatever the excellence of their contents may be—certainly never cost as much to produce. In the interest of science a strong protest against these inflated prices seems very desirable.

Yours, &c.,

H. STANLEY REDGROVE, B.Sc., F.C.S.

191, Camden Road, N.W.1.

29th June, 1922.

* Admirably reviewed in your issue of April 7th, 1922.

MATTER AND ENERGY.

TO THE EDITOR OF "THE CHEMICAL NEWS."

SIR,—In your reviewer's notice of Prof. A. W. Stewart's book, "Some Physico-Chemical Themes," this Journal, June 23, 1922, p. 369, the following statement appears:—

"Whatever subsequent research may prove, it is beyond dispute that Ostwald has contributed considerably to the advancement of science, both by his own researches and by his inspiration of others. His belief in the fundamental importance of energy and his preference for this concept in place of that of matter, has recently received much support from Einstein's theory of Relativity."

With your permission, I should like to direct attention to a few considerations which the above calls to mind as being relevant to the problem of *matter and energy*. In the first place, Einstein's theory does not involve anything in the nature of a *model* or a *material mechanism*. Eddington, in his "Time, Space and Gravitation," says: "Einstein . . . deduces a great number of remarkable phenomena solely from two general principles, aided by a mathematical calculus of great power; and it leaves aside as irrelevant all questions of mechanism." It is purely a system of analysis and, while Einstein holds the view that the atom is in some way characterisable by the energy it contains (e.g., its mass may be due to confined energy), the existence of atoms as discrete and measurable entities is in no way negated by the Relativity Theory. This theory gains in strength because it does not specify the nature of the mechanism involved in the phenomena considered or elucidated by the theory. At the same time, this lack of model characteristics is its weakest point, for great strides have also been made in the example of the atom by considering the atom as an entity with mechanical and electrical properties; but, as pointed out by N. R. Campbell, mechanical-model theories are liable to greater error than purely mathematical theories, because the former of necessity states more and consequently the danger of error is greater.

Any attempt to eliminate the term *matter* seems to be doomed in the long run, for however we may construct atoms and electric fields, the self-contained entity characteristic of atoms implies something which convention and convenience may sum

up by the term *matter*. We might almost as well try to eliminate the atom from consideration. It is true that the atoms are supposed, with good reason and abundance of experimental proof, to be composed of positive electrons (protons) and negative electrons. The negative electron has been described as a singularity in the aether. If the positive electron is an opposite singularity in the aether, we have two singularities, and by such ultimate terms we can avoid the use of the older terms which have a greater value because their extended definition is not attempted. Why, then, should we disparage the use of the word *matter*?

Aston's work on isotopes is an example of the materialness of the atom. Not a long time ago it was suggested that the appreciable atomic-weight fractions were due to the confined energy within the atom arising from different energy contents in different cases. It is now known that the *appreciable* fractions (except in the case of hydrogen)* arise from the presence of isotopic atoms,* and these fractions are simply average figures and nothing more. We cannot say that the decimal fraction of chlorine, 0.46, is directly due to an energy condition; for this fraction is only a mean figure since chlorine is made up of atoms of masses 35 and 37 in such proportions as to give a mean value of 35.46. This was discussed in the *Chemical News* (Vol. CXI., p. 181, April 16, 1915) by the present writer. Relatively enormous energy is nevertheless involved in atomic disintegration, and there are reasons for supposing that all atoms contain, relatively to their size, great amounts of internal energy, but one must avoid rushing to extremes in drawing conclusions. It is somewhat difficult in these times of great advance by totally different methods not to lose sight of the importance of one when absorbing the other. Within limits, two views apparently leading in opposite directions may be right, so long as we interpret them in the light of the experimental facts which are supposed to guide us. Modern developments in pure science lead to conflict in ideas, and it is a fact that, as Prof. Bragg has remarked, on several days in the week we may work with one theory, and on the other days with another theory, though we, in our ignorance, are unable to reconcile the two theories themselves.

It cannot be denied that these advances in science, as conflicting as they seem, are

truly fascinating, and one awaits with keen interest the experimental developments.

It has been remarked that the statement of modern views may be such as to leave the reader in doubt as to the proper choice of view, and that it would have been better if the statement had been crystallised into some definite form. Until this can be done with absolute certainty, it seems desirable to leave the final shaping of the argument until more is known.—I am., &c.,

F. H. LORING.

June 25th, 1922.

* There may be some exceptions to this rule, but in general it is true.

PROCEEDINGS AND NOTICES OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING—JUNE 22, 1922.

G. I. TAYLOR, F.R.S. *The Motion of a Sphere in a Rotating Liquid.*

The problem attacked in this paper is that of finding solutions to the equations of motion of a rotating fluid when a sphere is moved uniformly along the axis of rotation. It is shown that there are an infinite number of such solutions which satisfy the required boundary conditions and the conditions at infinity. They are characterised by a system of spherical rotational waves which accompany the sphere in its motion. The stream-lines are drawn for a particular case.

It is found that the radius of the sphere may be reduced to zero without reducing the disturbance in the fluid to zero. The equations then represent a motion which is finite and continuous at the centre (*i.e.*, centre of the sphere of zero radius), and consists of a central core or lump of fluid which rotates more slowly than the surrounding fluid and travels along the axis with a constant speed.

Experiments are also described in which some of the conclusions are verified with celluloid spheres moving in rotating tanks full of water.

PROF. T. R. MERTON, F.R.S., and D. N. HARRISON. *On Errors arising in the Measurement of Unsymmetrical Spectrum Lines.*

It is shown that the instrumental displacements which frequently occur whilst

spectra are being recorded photographically, can be rendered innocuous, for wave-length determinations, only in the case in which it is known that the spectrum lines are symmetrical.

In the case of a uniform displacement of a spectrum line during an exposure, the maximum on the photographic plate lies at the point where the intensity distribution curves at the beginning and end of the exposure intersect. In the case in which the intensity distribution curve is such that the ratio of the widths on either side of the maximum remains constant for all values of the intensity, the displacement of the maximum is related in a simple manner to the "index of asymmetry" of the line.

E. F. ARMSTRONG, D.Sc., F.R.S., and T. P. HILDITCH, D.Sc. *A Study of Catalytic Actions at Solid Surfaces. Part VIII.—The Action of Sodium Carbonate in promoting the Hydrogenation of Phenol. Part IX.—The Action of Copper in Promoting the Activity of Nickel Catalyst.*

Part VIII.—In this part an account is given of the stimulating action of small amounts of mild alkali, especially anhydrous sodium carbonate, upon hydrogenation of phenol in the liquid state in presence of nickel. We have established the following facts:—

(i) The amount of sodium carbonate present has a specific influence—as the quantity is increased, the hydrogenation is accelerated until a certain point is reached, after which the rate of action again falls off.

(ii) The optimum amount of sodium carbonate is about 25 per cent. of the weight of metallic nickel present, and bears a constant ratio to the latter and not to the amount of phenol present.

(iii) The hydrogen-absorption time curves for phenol in presence of nickel and in absence of sodium carbonate are of logarithmic type; in presence of the optimum concentration of carbonate, however, they become approximately linear.

It is deduced that the action of the sodium carbonate is a protective one with respect to the catalyst, and not a true acceleration; it is rather the suppression of a retarding or poisoning influence, leaving the nickel free to exercise its normal function. Whilst the actual toxic agent has not been identified, it would appear in the light of these results to be some too stable association between the nickel and phenol (or a

product from the latter). The cause may possibly be formation of nickel phenate.

The authors propound no general theory of "promoting action" induced on catalysts.

Part IX.—In this part the production of catalysts by reduction of mixed copper-nickel carbonates below 200° C. has been studied, and it is emphasised that comparison between catalysts should be made under conditions in which the simple catalyst (nickel alone) is mechanically distributed to give maximum surface area.

In this way it was found that copper-nickel catalysts prepared at 180° C. are not so highly active as the plain nickel catalyst reduced at a higher temperature, but nevertheless display considerable activity. Only certain nickel-copper carbonates give rise to active catalysts, and to obtain maximum activity in the product it was necessary so to prepare the mixed carbonates that nickel α -cupri-carbonate was present in the precipitate.

The preparations which yielded active catalysts responded to Pickering's tests for complex cupri-carbonates; those which yielded inactive products gave negative results in these tests. The amount of reduced nickel in the active products was small, and never more than 12-15 per cent. of the total quantity present.

It is suggested that the production of reduced nickel at the low temperature of 180° C. from a nickel cupri-carbonate is conditioned by the heat liberated in the reduction of the copper, which may give rise momentarily to a local temperature in the complex carbonate molecule far higher than the recorded external temperature.

E. A. MILNE. *Radiative Equilibrium: The Relation between the Spectral Energy Curve of a Star and the Law of Darkening of the Disc towards the Limb, with special Reference to the Effects of Scattering and the Solar Spectrum.* Communicated by Prof. H. F. Newall, F.R.S.

It is shown that for stars in radiative equilibrium the darkening of the disc towards the limb in wave-length λ depends only on the product λT , T being the effective temperature. The ratio of the intensity at the limb to that at the centre increases as λT increases, but never exceeds 0.8; it approaches zero for small values of λT . For stars not in radiative equilibrium the coefficient of darkening in the integrated radiation must lie between $3/5$ ths and $\frac{1}{2}$.

and the temperature distribution near the surface can be deduced from the observed value.

These results hold on the assumption of "gray" material, *i.e.*, material for which the coefficient of absorption is independent of wave-length. Selective absorption in the continuous spectrum alters the law of darkening, giving increased contrast in the relatively more intense parts of the spectrum. The effect of a scattering atmosphere round a star should be to make the coefficients of darkening in all wave-lengths tend to the same value, about $3/5$ ths.

Though the continuous solar spectrum differs considerably from a black-body spectrum, the observed darkening differs very little from the theoretical darkening for radiative equilibrium. For the sun it is not possible to correlate the spectrum with the darkening, either on the hypothesis of selective absorption or on that of a scattering-atmosphere. It is inferred that there is no scattering atmosphere of appreciable optical thickness round the sun, and that the bulk of the emergent radiation is not scattered light.

C. N. HINSHELWOOD. *On the Structure and Chemical Activity of Copper Films and the Colour Changes accompanying their Oxidation.* Communicated by Prof. J. W. Nicholson, F.R.S.

1. The gradual activation of a copper surface in a series of oxidations and reductions has been studied by measurements at pressures of a few millimetres.

2. A limiting state appears to be reached in which the copper film has an open structure consisting of granules whose radius is found to be a small fraction of 1μ .

3. During oxidation brilliant diffraction colours are observed, which depend upon the composition of the separate granules. Measurements of the composition of the granules in films showing the various colour stages are given.

4. Upon optical observations and upon the study of the kinetics of the oxidation and reduction is based a suggestion as to the mechanism by which the film is brought into the granular condition.

R. C. RAY. *Heat of Crystallisation of Quartz.* Communicated by Dr. M. W. Travers, F.R.S.

(1) The specific heats of aqueous hydrofluoric acid of different concentrations have been determined and the results recorded in a Table (I.).

(2) The heats of solution of quartz and silica glass in aqueous hydrofluoric acid have been determined (Table II.), and the difference which represents the heat of crystallisation of quartz at the ordinary temperature is found to be equal to 6.95 kilogram calories.

(3) From determinations of the heats of solution (Table III.), it has been shown that grinding affects the crystalline material, which is partially converted into the vitreous state.

(4) The latent heat of crystallisation of quartz has been calculated at higher temperatures, and it is shown that near the melting point the heat of crystallisation of quartz is probably very nearly equal to that of the air temperature.

C. G. SCHONEBOOM. *Diffusion and Intertraction.* Communicated by Sir E. Rutherford, F.R.S.

It has been proved by experiments, so planned as to exclude the influence of convection currents due to mechanical or thermal influences, that in addition to diffusion there also comes into play in connection with fluid-mixing another specific operating factor, which has been called "Intertraction."

Clerk Maxwell, in discussing the question of interfacial tension, came to the conclusion that an interpenetrating movement of this kind, although it had never been described, was *a priori* to be expected as the result of negative interfacial tension.

The occurrence of the phenomenon has been described by Sir Almoth Wright in the special case of the admixture of serum and salt solutions, but it is shown in the experiments detailed in this communication that it is a general phenomenon which can be obtained with practically any substance in any solvent.

THURSDAY, JUNE 29, 1922, AT 4.30 P.M.

Papers read:—

Sir J. J. Thomson, O.M., F.R.S. On the Analysis by Positive Rays of the Heavier Constituents of the Atmosphere: of the Gases in a Vessel in which Radium Chloride had been stored for 14 years; and of the Gases given off by Deflagrated Metals.

Sir Robert Hadfield, F.R.S. The Corrosion of Iron and Steel.

W. B. Dawson, D.Sc. Harmonic Tidal Constants for Standard Ports of Reference

in Canada. Communicated by Prof. F. D. Adams, F.R.S.

Prof. J. C. McLennan, F.R.S., and M. L. Clark. On the Excitation of Characteristic X-rays from Light Elements.

J. C. Bramwell. An Abnormal Relationship of the Electrical to the Mechanical Response in the Ventricles. Communicated by Prof. A. V. Hill, F.R.S.

T. S. P. Strangeways. Observations on the Changes seen in Living Cells during Growth and Division. Communicated by Mr. W. B. Hardy, Sec. R.S.

And other papers.

ROYAL INSTITUTION OF GREAT BRITAIN.

Albemarle St., Piccadilly, W.1.

A General Meeting of the members will be held on Monday, July 3, 1922, at 5 p.m.

SOCIETY OF GLASS TECHNOLOGY.

REPORT OF THE MEETING HELD ON
WEDNESDAY, JUNE 21ST, 1922.

The members of the Society of Glass Technology, who met at the University of Sheffield, under the presidency of Prof. W. E. S. Turner, were disappointed to learn that the American Ceramic Society had decided to postpone their visit to this country until next year. The members of the Society had been expected to spend three or four weeks in this country in September, and a draft programme had already been prepared of visits to various glass and pottery centres. In view of the postponement, the Society decided to re-issue their invitation for next year, and also to approach the British Ceramic Society with the suggestion that that body should join in the invitation and arrangements.

Various interesting questions concerning glass-making were discussed at the meeting. A paper was received from a Japanese member, Mr. Y. Amenomiya, on "The Devitrification caused upon the Surface of Sheet Glass by Heat." The glass referred to is that used for windows, and it is known that heat causes devitrification, or crystallisation. The object of the tests described in the paper was to find the temperature at which this alteration took place, and it was discovered that the danger region was from 700 to 800° C.

Two papers were read by students of the Department of Glass Technology on research work they had carried out under the direction of Professor Turner. Mr. K.

Kamita gave an account of the work he had done on the influence of alumina in preventing the devitrification of sheet glass during the drawing process. From seven melts of a standard glass to which had been added various quantities of alumina, he showed that as the amount of alumina in the glass increased so the temperature at which devitrification occurred was raised; 5 per cent. of alumina causing a rise of approximately 100° C. in the temperature at which devitrification commenced.

Mr. L. E. Norton gave an account of the work he had done on the swelling of sand on the addition of water. This matter was of importance, because many glass manufacturers still have their batch materials measured out instead of having them weighed out. Three typical sands were used in the experiments, and it was shown that in each case the addition of water caused such a swelling in the sand that the moist sand would more than fill a vessel which would hold the same sand when dry. This excess sand may be as much as 12 or 15 per cent. of the total dry sand. In each of the three cases there appeared to be a maximum amount of swelling when about 5 or 6 per cent. of water was mixed in with the sand.

Professor Turner gave a short paper on the mixing of batch, in which he compared the efficiency of hand mixing with mixing by machine. Taking three samples from a batch mixed in the ordinary way by hand, he found the maximum variations were from 44 to 77 per cent. sand and 4.8 to 8.3 per cent. lime, while a somewhat similar batch mixed by machine showed variations of from 69 to 73 per cent. sand and 4.2 to 6.6 per cent. lime.

Machine mixing, by giving a much more regular batch, assisted the melting, and materially reduced the time necessary for the production of good glass.

An interesting discussion followed each of the papers.

During the morning a party of members visited the new works of the Department at Darnall Road, Sheffield.

It was pointed out that this was the last meeting of the present session. The new session will open in October, when the Society will probably visit York, to inspect the wonderful stained glass in the Minster.

BOOKS RECEIVED.

Chemical Lecture Diagrams. DR. GEORGE FREY MARTIN, D.Sc. (Lond.), Ph.D., &c. Pp. 88. 1922. Sampson, Low, Marston & Co., Ltd., 100, Southwark Street, S.E. Price 3s. 6d. net.

Proteins, and the Theory of Colloidal Behavior. JACQUES LOEB. Pp. XI. + 292. First Edition. Messrs. McGraw-Hill Publishing Co., Ltd., 6 & 8, Bouverie Street, E.C.4. Price 15s. net.

The Calculations of Analytical Chemistry. EDMUND H. MILLER, Ph.D., Professor of Analytical Chemistry in Columbia University. Pp. X. + 201. Third Edition. 1922. The MacMillan Company, St. Martins Street, W.C.2. Price 9s.

Chemical Lecture Diagrams. DR. GEORGE FREY MARTIN, D.Sc. (Lond.), Ph.D., &c. Pp. 88. 1922. Sampson, Low, Marston & Co., Ltd., 100, Southwark Street, S.E. Price: 3s. 6d. net.

NOTICES OF BOOKS.

A Textbook of Inorganic Chemistry. Edited by J. NEWTON FRIEND, D.Sc., Ph.D., F.I.C. Vol. IX., Part II.: *Iron and its Compounds.* Pp. XV. + 265. London: Charles Griffin & Co., Ltd., 1921. Price 18s.

Part II. of Vol. IX. of Dr. Friend's Textbook has been written by himself, and deals with Iron and its Compounds. Nothing is said concerning the metallurgical chemistry of iron which will be covered by another part (III.).

Whilst the chapters on the history and corrosion of iron are especially informative and complete, comparatively little is said concerning the industrial applications of iron compounds.

The arrangement of the matter is unusual and follows the periodic classification of the elements. Thus chapter VI. deals with the compounds of iron with hydrogen and the halogens; and chapter VII., entitled *Iron and the Elements of Group VI.*, includes accounts of the oxides, hydroxides, sulphides, sulphates, alums, thionates, and many other salts.

There are copious references to the literature of iron and its compounds. The utility of this volume is enhanced by the inclusion of "Tables of Dates of Issue of Journals,"

since some have appeared irregularly and others have volumes commencing in one year and extending into the next.

The book will become a standard work of reference on the metal, and will be freely consulted by those interested.

J. G. F. D.

Laboratory Outline to General Chemistry, by H. N. MCCOY and ETHEL M. TERRY. Pp. VII. + 155. New York: McGraw Hill Publishing Co. (London: 6-8, Bouverie St., E.C.4), 1920. Price 7s. 6d.

This brief Laboratory Outline has been written to accompany the authors' "Introduction to General Chemistry," to which frequent cross references are made in the text. The two books together furnish the basis of a first year's course in chemistry.

A few paragraphs on chemical arithmetic have been inserted, and lists of apparatus are given in the form of an appendix.

Unfortunately, the book may not receive adequate consideration in England, owing to dislike of the American spelling of sulphur, etc.

J. G. F. D.

The Determination of Hydrogen Ions, by W. MANSFIELD CLARK, M.A., Ph.D. Pp. 317. Baltimore: Williams and Wilkins Company. 1920.

A conception of the great utility of the methods of physical chemistry in applied science is gained by a perusal of this work of Dr. Clark, who is engaged at the Research Laboratory of the Dairy Division, U.S. Dept. of Agriculture.

The book includes a full account of acid and base equilibria, the effect of dilution and the behaviour of strong electrolytes. The theory and application of Indicators is then dealt with, and its limitations are pointed out. A chart shows the colours of eight synthetic indicators at nine different hydrogen ion concentrations (from acid to alkali).

There is a full account of the electro-metric methods for determining hydrogen ion concentrations, together with the theory of hydrogen, and calomel electrodes, potential differences at liquid junctions, and apparatus receives adequate notice.

The useful chapter on Applications is rather too condensed, but the bibliography is very considerable, occupying over 60 pages.

A portrait of Prof. Sørensen, who has so largely applied the ionic theory to biological science, forms the frontispiece.

The author dedicates his work to his "Fellow Workers in the Biological Sciences," and these will welcome his valuable contribution to the literature of applied physical chemistry. J. G. F. D.

Chemical Engineering. by EDWARD HART, PH.D. Pp. XII. + 211. Easton, Pa: The Chemical Publishing Co., 1920. Price \$4.

Among the various industrial processes dealt with in this interesting book, mention may be made of Solution, Filtration, Evaporation, Crystallisation, and Drying. Boilers and Machinery receive fairly adequate treatment. The chapter on Materials is one of the best and most informative, but the author is inclined to err on the side of brevity, and confines himself to a description of only one of each kind of plant (all American). Only modern types are included. Not only are obsolete processes omitted, but very few comparisons are made. From the students' standpoint this is regrettable.

Very few errors occur in this well-printed volume. The word *resistivity*, on p. 12, could be altered to *resistance* in future editions, and some of the 200 illustrations could be improved upon, although most are quite good. Fig. 195 is merely a repetition of Fig. 73.

There is a need for books of this type, and Dr. Hart's volume should be of service to chemical engineers and to students.

J. G. F. D.

Practical Biological Chemistry, by G. BERTRAND and P. THOMAS. Translated from the Third Edition by HECTOR A. COLWELL, M.B., D.P.H. Pp. XXXII. + 348. London: G. Bell and Sons, Ltd., 1920. Price 10s. 6d.

The chief feature of this work is its broad and practical character. Part I. (Statics) includes a brief systematic account of the detection and estimation of the elements, and descriptions of groups of organic compounds of biological importance. Numerous tests, preparations and estimations are incorporated.

Part II.—Dynamics—deals with the various enzymes and their actions, microbiology, fermentations and the chief products therefrom, and certain synthetic processes. The laboratory experiments described are of fundamental importance, and illustrate the properties of bodies of biological interest. It is noticeable that certain methods have been selected for fuller treat-

ment. Thus, there is a long account of the estimation of sugars by Bertrand's method, and also of Duclaux's noteworthy method for identifying and estimating volatile acids.

The translator has added a few useful notes, but hydroquinone is miscalled a *diatomic* phenol (p. 100). A more typical apparatus for distillation *in vacuo* could have been figured on p. 99.

The book is well adapted for the use of medical students and others. It should appeal to those who teach biochemistry.

J. G. F. D.

CHEMICAL NOTICES FROM FOREIGN SOURCES

VOLUMETRIC DETERMINATION OF AMMONIA.

—E. J. Kraus.—A volumetric method can conveniently be used to determine small quantities of aluminium, as, for example, in a precipitate obtained from waters which are rich in aluminium. The method depends upon the fact that when an alkaline phosphate is added to a liquid containing the ions, Al^{+++} and Ag^+ argentic phosphate, Ag_3PO_4 , is not precipitated until all the aluminium has separated in the form of aluminium phosphate, $AlPO_4$. The aluminium must be present in a neutral or very feebly acid solution. The precipitate of $Al(OH)_3$ is dissolved in dilute sulphuric acid, two drops of a solution of silver nitrate are added, and then some disodium phosphate solution of known strength, till a yellow precipitate is obtained. It is best to warm the solutions, as it is then easier to see the yellow colour of the silver phosphate.—(*Chem. Ztg.*, 1921, 1173).

HYPOTONIN.—Th. Sabalitschka. Hypotonin is an iso valerianate of ethylene diamine, in which an anine which lowers the blood pressure is associated with an acid having a sedative action. It is a white powder with a smell resembling that of valerian, and a sweet taste. It fuses at $129-130^\circ$. At the ordinary temperature it dissolves in less than its own weight of water and in four parts of absolute alcohol. It is less soluble in chloroform, and only slightly soluble in ether. The aqueous solution is feebly acid towards litmus. With sulphuric acid it yields an oily, colourless liquid, smelling strongly of valerian, and when boiled with caustic soda solution it gives off vapours with a peculiar smell, which are not ammoniacal, but which do turn damp litmus paper blue. If a glass rod previously dipped in hydrochloric acid is brought into the vapour a white cloud of

ethylene diamine is obtained. When ignited hypotonin gives a residue amounting to only 0.1 per cent. of its weight.—(*Pharm. Ztg.*, 1922, 327.)

BENZYL DI-ALKYLATED CYANIDES, AND THE CORRESPONDING ALCOHOLS, AMINES, AND ACIDS.—*Joseph Blondeau.*—The di-alkylated cyanides of benzyl can be prepared from the monoalkylated cyanides by treating them with the theoretical quantities of sodium amide and methyl iodide. When these cyanides are saponified with potash and alcohol, the corresponding amide is obtained, with traces only of acid, and the amides can readily be reduced by means of sodium and absolute alcohol, the corresponding alcohols being thus obtained. The author has prepared many compounds of these types, and has studied their properties.—(*Comptes Rendus*, CLXXIV., 1922, 1424.)

ACTION OF ACETYLENE UPON THE SODIUM-KETONES AND THE PREPARATION OF DIALKYL-ETHINYLCARBONOLS.—*R. Locquin and Sung Wouseng.*—When the sodium derivatives of various ketones are shaken with acetylene at a temperature of 0° and under a pressure of $\frac{1}{2}$ an atmosphere, the gas is rapidly absorbed and tertiary acetylenic alcohols are obtained. They are mobile liquids, characterised by their phenylurethanes and by their allophanates. They give an argentic derivative which is unaffected by boiling water. When hydrogenated in presence of platinum black or reduced nickel they yield the corresponding tertiary saturated alcohol. Some condensation products of the ketone with itself are also obtained by the reaction and bitertiary acetylenic γ -glycols existing in two stereo isomeric forms.—(*Comptes Rendus*, CLXXIV., 1922, 1427.)

METHOD OF PREPARING BISMUTH CITRATE AND TARTRATE.—*M. Fabrègue.*—Bismuth citrate can be prepared by dissolving neutral bismuth nitrate in acetic acid, and shaking the solution with sodium citrate. A white precipitate of bismuth citrate is thus obtained. It is insoluble in water, alcohol, ether, and dilute acids; but soluble in water containing ammonia, giving double salts. It is slightly acid towards litmus. It gives more or less basic salts when neutralised with ammonia or caustic soda or sodium carbonate and evaporated to dryness. Bismuth tartrate can be prepared by the same method, using sodium tartrate instead of citrate. It is a white crystalline powder,

very closely resembling the citrate, and it can be used for intra-muscular injections instead of the latter.—(*Journ. Pharm. Chim.*, L., 1922, 341.)



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 16086 Aktieselskabet Norske Saltverker.—Process of producing anhydrous magnesium chloride. June 9.
- 15856—Chemische Fabrik, J. A.—Process for production of water-soluble permanent preparations containing acetylsalicylic acid. June 7.
- 15872 Maxted, E. B.—Manufacture of nickel catalyst for hydrogenation of oils, etc. June 7.
- 16170—May & Baker, Ltd.—Manufacture of 3:3'-diamino 4:4'-dihydroxyarsenobenzene, etc. bases. June 10.
- 15741—Schindelmeyer, J.—Production of camphor, borneol, and isoborneol. June 6.

Specifications Published This Week.

- 160161—Kansas City Gasoline Co.—Art of cracking hydrocarbons.
- 180433—Imray, O. Y.—Manufacture of mordant dyeing dyestuffs and chromium compounds thereof.
- 161161—Christenson, O. L.—Method of producing ammonium chloride in combustions or distilling alum, slate or similar bituminous shales.
- 169948—Christenson, O. L.—Method of producing ammonium chloride from shales.
- 180546—Gallard, E. A.—Manufacture of sulphuric acid.
- 180611—Wilson, Bros.—Vegetable charcoal.

Abstract Published This Week.

Ammonium Sulphate.—Patent No. 178046.—Some improvements in the manufacture of ammonia sulphate have been Patented by Mr. R. Lessing, of 317, High Holborn, London.

The paste of crystals discharged from the saturator is allowed to drain under conditions which prevent further crystallization during the draining process. Preferably the paste is discharged into a closed draining-vessel, which is heated to a temperature not above that of the crystals. The process may be carried out in conjunction with that described in Specification 152766, for improving the colour of ammonium sulphate.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

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THE CHEMICAL NEWS, JANUARY 26, 1923.

THE
CHEMICAL NEWS

AND

JOURNAL OF INDUSTRIAL SCIENCE.

WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE."

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IN THEIR APPLICATION TO

ENGINEERING AND MANUFACTURES.

EDITED BY

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No. 3248. — JULY 11, 1922.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3248

SAFEGUARDING OF INDUSTRIES ACT.

AWARDS IN ARBITRATIONS UNDER

SECTION 1 (5).

Judgment has been given by the Referee in Arbitrations relating to the following complaints under the above Sub-Section.

In accordance with the Award, "Acid Boric" is removed from the lists of articles chargeable with duty under Part I. of the Act as from 29th June:—

Nature of Complaint.

1. That "Acid Boric" is improperly included in the lists of dutiable articles.

2. That Re-agent Bottles, Hydrometer Jars, Museum Jars, Specimen Jars, Surgical Jars, Cylindrical Measures (bell-shaped) and Conical Measures, are improperly included in the lists of dutiable articles.

Judgment.

1. That "Acid Boric" be removed from the lists.

2. Text of Award given below.

THE REFEREE'S AWARD.

Scientific Glassware.

In my opinion the question whether the descriptions complained of are properly included in the list of dutiable articles depends upon the meaning of the words used. I am satisfied that all the descriptions complained of are properly included in the list provided that these descriptions are used strictly and within the limits which are defined in this award. Re-agent bottles are properly in the list provided that by the expression "re-agent bottle" is meant a bottle which is reasonably fit for containing chemical re-agents. The legal obligation implied on the sale of such bottles is that the bottle shall be reasonably fit for containing any ordinary chemical re-agent, not

fit for just a few but fit for any chemical re-agent except possibly some exceptional substance calling for special and exceptional qualities in its container. This obligation means that the bottle must be made of hard suitable glass free from lead. By "free" I mean containing no more than such a trace as does not matter. The neck and stopper must be ground so as to make a perfectly air-tight joint.

If a bottle does not fulfil these requirements, it is not suitable for containing chemical re-agents, and is not scientific glassware. I gather that the distinctive shapes of re-agent bottles have been copied and that the description has been applied to inferior bottles, and that these practices have led to trouble with the Customs. That trouble is not for me to deal with.

A hydrometer jar means a jar suitable for hydrometer tests. It is of distinctive type, straight sided, of circular or elliptical section from 6 inches to 10 inches high. The glass must be good and very clear. The jar must be a very good cylinder and must be capable of standing rapid changes of temperature.

Cylindrical Measures (Bell-Shape) and Conical Measures.

I think that these measures are on the border line, and that the only articles of these descriptions which can properly be considered as scientific glassware are measures which are in fact graduated with scientific accuracy. It is the correct graduation which, according to the evidence, makes them scientific glassware. I award that the descriptions complained of are properly included in the list if and when defined within the limits I have laid down. The complaint therefore fails.

(Signed) CYRIL ATKINSON.

12th June, 1922.

[From the *Board of Trade Journal*, June 29th, 1922, page 719.]

DEHYDROTHIOTOLUIDIN: ITS ISOMERS, HOMOLOGUES, ANALOGUES, AND DERIVATIVES.

By MARTIN MEYER, B.Sc., M.A.

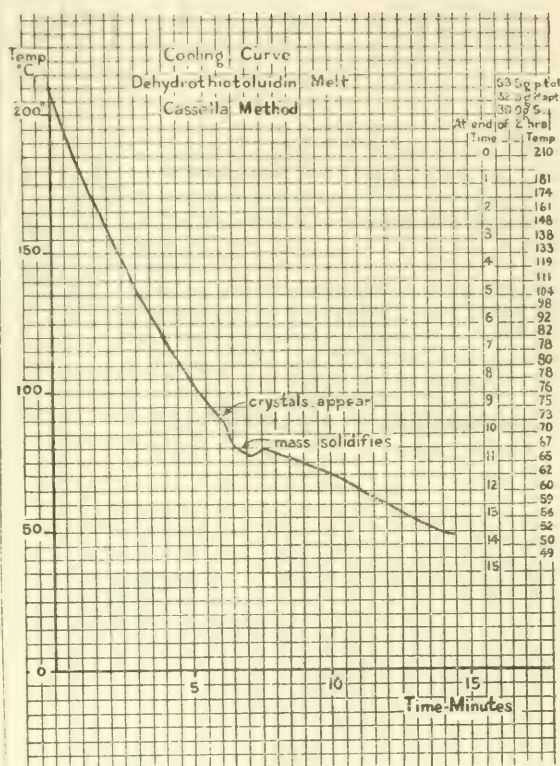
NEW YORK CITY.

(Continued from Last Week).

2. The Kalle Method.

It was observed that the relative amount of naphthalene as required in the Casella Method could be varied greatly, without affecting the yield. (In order to determine whether there was compound formation between the naphthalene and the other substances in the melt, a cooling curve was taken, which indicated that there was not, as may be seen from the diagram.) The naphthalene was then omitted entirely, the fusion being carried out as directed in the Kalle patent, but extraction was still used for purification, and the yields and results were the same as those just described. It was therefore concluded that the claim that the use of naphthalene increases the yield is unfounded, its only advantage being as a temperature regulator.

The method of purification by vacuum distillation was next tried in a preliminary way. For this purpose melts prepared by the Kalle method as well as samples of the crude material made similarly by the Du-Pont Co., were used. These melts distilled around 345° C. at a pressure of 35 mm. and yielded a product which on a single crystallisation from alcohol appeared in very pale yellow, odourless needles, which on further recrystallisation from ethyl alcohol were finally obtained at a constant melting point of 194.8° C. (cor.). This was undoubtedly pure and probably the purest sample of the compound which has been prepared up to this time. The procedure is a difficult one to carry out, the yields here were less than 20 per cent. of the weight of the starting material, and the distillation was accompanied by much foaming and decomposition, the greater part of the starting material remaining in the flask as coke at the end. As this was, however, finally concluded to be the only feasible method of purification, the complete details will be given later.



3. Attempt to Develop a New Synthesis of Dehydrothiotoluidin.

The work done on the compound up to this point led to the conclusion that in order to prepare a quantity of the substance sufficient for further investigation, and in a satisfactory state of purity, a new synthesis would be highly desirable. The criteria for this reaction as a laboratory problem are:

- (a) Simplicity of mechanical operations.
 - (b) Large yield.
 - (c) Avoidance of the formation of primulin which prevents the satisfactory crystallisation of the compound without introducing large quantities of other by-products.
 - (d) Availability of starting materials.
- From consideration of the general methods by which thiazoles have been prepared, the following proposed syntheses are obvious at once:

- (a) Condensation of para-amino-meta-thiocresol with para-amino-benzoyl chloride.
- (b) Fusion of para-amino-benz-para-toluidid with sulphur.

(c) Oxidation of thio-para-amino-benz-para-toluidin with potassium ferricyanide.

(d) Fusion of paranitro-benzal-para-toluidin with sulphur analogously to the patent method for preparing "Rosenkörper."⁷³ It was hoped that in this reaction, if it occurred at all, the hydrogen sulphide formed would reduce the nitro group to the amine, otherwise a final reduction would be necessary. This method was chosen as the easiest to perform because it is readily seen that the required Schiff's base should be easily obtained by condensation of paratoluidin and paranitrobenzaldehyde. This expectation was justified and the compound was prepared just before the publication of the article by Lowy and King⁷⁴ on the condensation products of paranitrobenzaldehyde in which it is described.

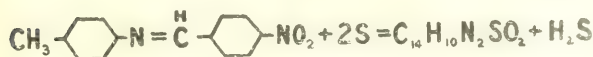
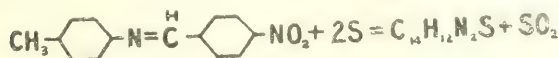
4. Para Nitro Benzal Paratoluidin.

Large quantities of chromyl chloride were prepared by the method of Law and Perkin,⁷⁵ and paranitrobenzaldehyde by that of V. V. Richter.⁷⁶

Molecular quantities of the two substances, paratoluidin and paranitrobenzaldehyde, are dissolved separately in the least amounts of 95 per cent. ethyl alcohol and refluxed for one hour after mixing. The solution is evaporated to a small volume, allowed to crystallise, and the product filtered off and recrystallised from ethyl alcohol. Paranitrobenzal-paratoluidin appears in pale yellow needles melting at 123° C. (cor.). The yield is only about 50 per cent. of the theoretical in a pure state as it is very soluble in alcohol and the losses during crystallisation are large.

5. Fusion of Paranitro-Benzal-Paratoluidide with Sulphur.

It was expected that on fusion with sulphur this compound would behave in one of two ways, or perhaps, both, as follows:



resulting either in the formation of dehydrothiotoluidin or the corresponding nitro derivative.

Accordingly 16 g. of the Schiff base and 4 g. of powdered roll sulphur were mixed intimately and used on an oil bath in a flask equipped with a reflux condenser for 1½ hours at 200° C. Vigorous ebullition occurred almost at once, and sulphur dioxide was evolved rapidly. The mass became viscous at the end of three-quarters of an hour and was almost entirely solid at the end of one hour. Allowed to cool, broke the flask and pulverised the melt, which was black in colour and weighed 16 g. It was then extracted twice with concentrated hydrochloric acid in 100 cc. portions which were diluted with water, neutralised with sodium hydroxide and filtered. The acid solution changed from yellow to a milky purple at the neutral point. A small amount of purplish-brown material, the dry weight of which was less than 1 g. was obtained. The mass appeared to have charred to a large extent and the yield was too small to proceed further with. It was not dehydrothiotoluidin or the nitro compound, and resembled the product obtained later from nitrotoluene in every way.

It was thought that a lower temperature might improve the results, so the experiment was repeated, using xylenes as a diluent and temperature regulator.

A mixture of 12 g. of paranitrobenzal-paratoluidin, 55 cc. of xylenes, and 3 g. of sulphur, was refluxed for 5 hours, the mixture was then diluted with water and steam distilled, and the xylene recovered from the distillate. The residue in the flask consisted of a dark brown solid and a yellow substance, more of which is deposited in yellow needles from the water solution on cooling. Filtered and separated the yellow needles from the brown material which was present in large lumps. None of the starting material was obtained from this, although the brown mass did contain free sulphur. The products of the reaction were the brown, amorphous, insoluble material, and the yellow crystals, which are soluble in alcohol from which they crystallise in small crystals of indistinguishable shape, melting at 227-228° C. (cor.). The water solution of this compound is acid to litmus, qualitative analysis showed the presence of carbon, hydrogen, and nitrogen, and a sample gave the reduction test for the nitro group. It was not investigated further as it was evidently not the desired sulphur base.

6. Fusion of Paranitrotoluene and Sulphur.

At this point the thought suggested itself that paranitrotoluene should yield dehydro-

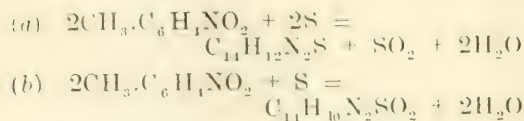
73. D. R. P., 51, 172; Friedländer, Vol. 2.

74. Lowy and King, J. A. C. S., 43, 627

75. Law and Perkin, J. C. S., 91, 191 (1907).

76. V. V. Richter, Berichte, 19, 106 (1886).

thiotoluidin or its nitro-body on fusion with sulphur by reactions similar to those already given.



A mixture of 30 g. of paranitrotoluene and 15 g. of sulphur was heated under a reflux condenser and for two hours sulphur dioxide was evolved vigorously. The melt, which on cooling weighed 29 g., was powdered and extracted three times with 100 cc. portion of concentrated hydrochloric acid which were then drowned in ten times their volume of water. On standing a dark brown flocculent precipitate settled out, and was filtered off and dried. It blackened up somewhat on standing, and weighed 7 g. when dry. The extract was pulverised and warmed with 100 cc. of ethyl alcohol, filtered, and the deep red solution was evaporated down and allowed to crystallise, yielding about a gram of light brown micro-crystals that appeared to sublime or decompose around 220° C. Qualitative analysis showed the presence of carbon, hydrogen, nitrogen, and sulphur. Zinc dust in 50 per cent. ethyl alcohol appears to react with the substance as it gives a yellow solution with a pale green fluorescence, but the reaction mixture does not reduce ammoniacal silver nitrate and consequently the original substance is not a nitro compound.

Gatterman and Neuberg⁷⁷ prepared dehydrothiotoluidin from thio-paranitro-benzotoluid by the Jacobson reaction. They describe the nitro compound as crystallising in yellow-red needles from glacial acetic acid, and none of the above mentioned substances resembles, even slightly, this or dehydrothiotoluidin.

The substance obtained in this reaction is a sulphur compound, probably identical with that obtained from para-nitro-benzal-paratoluidin, has some tinctorial value, and does not correspond to any that have been prepared. As it can be made easily in moderately large quantities, it might be worth while to investigate the reactions further, but as for the preparation of dehydrothiotoluidin, these experiments failed, this was not done.

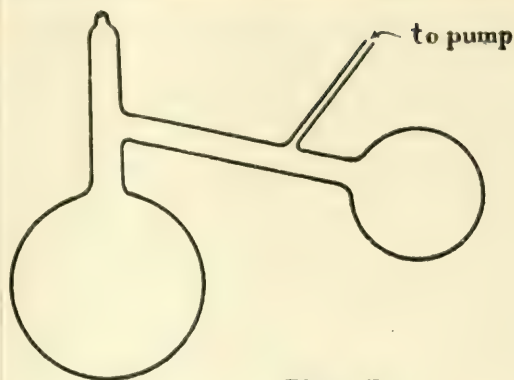


Fig. I

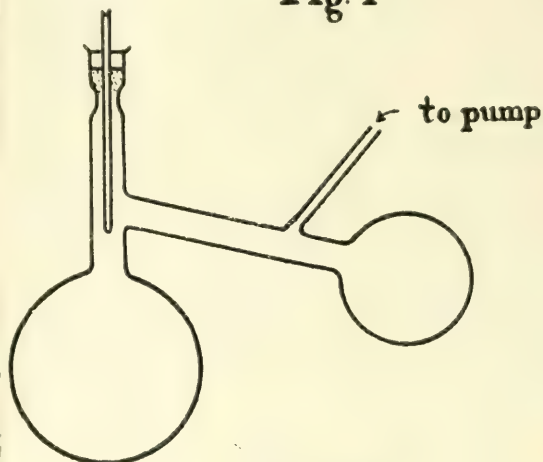


Fig. II

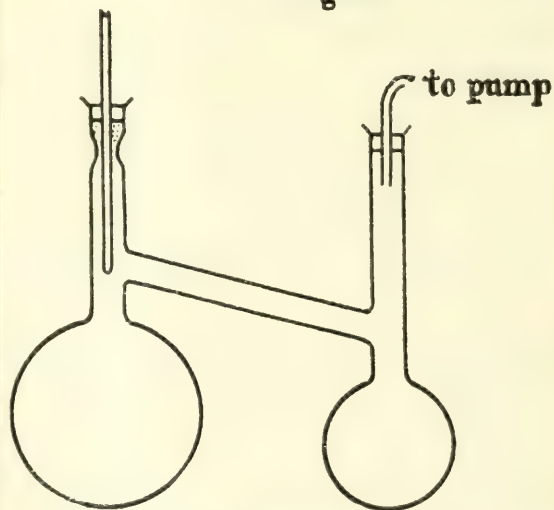


Fig. III

77. Gatterman and Neuberg, *Berichte*, 25, 1081 (1892).

7. Apparatus for the Vacuum Distillation of Dehydrothiitoluidin.

After attempting to prepare the compound in fairly large quantities by all of the known methods, and unsuccessfully trying to develop a new one, it was finally concluded that the Kalle method offered the only possibility, and purification must be accomplished by vacuum distillation. Preliminary work showed that the difficulties were mainly low yields and the tendency of the compound to swell up and run over during the process of distillation making it impossible at first to obtain more than 10 g. of the compound by this method in a single operation on a laboratory scale.

The apparatus first tried was the ordinary vacuum distillation set up. At the lowest pressures obtainable with a good water pump (20-30 mm.), dehydrothiitoluidin distills around 350° C., and it was found impossible to maintain a good vacuum at this temperature, using cork stoppers with the additional difficulty of more rapid decomposition as the pressure rose, while further, the narrow tube clogs up almost at once. The first step was to modify the apparatus as shown in the diagram (Fig. 1), the flasks being 250 cc. Pyrex ones sealed together, and then the whole apparatus was sealed up after the insertion of the mixed bases. The heating was done over a free flame. This had the disadvantage of ordinarily only being capable of one run of 50 g. of mixture (if more is used it will run over, because of the foaming and decomposition), as it requires too great a degree of manipulative skill to cut off the different parts at the end of the operation and then to seal them together again, it being less trouble to make a new apparatus, and in addition the closed arrangement did not give sufficient control of the run.

The next improvement (Fig. 2) was to draw out the neck of the distillation flask, pack the upper part with asbestos, and then close with a rubber stopper, through which a thermometer can be inserted, which is protected from the heat by the asbestos. This was a decided advance, as two or three successive small amounts (50 g.) of mixed bases can be placed in the main flask and distilled before it is necessary to break the apparatus to remove the yield, which disadvantage still remains.

The final and best type of apparatus is shown in Fig. 3. The distillation flask is a 500 cc. Pyrex one connected to a 250 cc. receiver by a 6-inch length of Pyrex tubing

of the same bore as the neck of the smaller flask. The set-up is evacuated through the neck of the receiver, and it is strongly recommended to place a U-tube of cotton wool between the safety bottle and the water pump during distillation, as otherwise, in spite of the best of cooling, the vapours will be carried along and clog up the water pump during distillation, and while this is being remedied there will be much loss of yield due to charring. Cooling is accomplished by immersing the receiver in a water-bath.

In this apparatus 100 g. (not more!) of the mixed base can be distilled at one run, yielding after crystallisation of the distillate once from 96 per cent. alcohol 22-25 g. of pure dehydrothiitoluidin. To avoid overheating, the distillation flask was heated in a sodium nitrate bath, but this was discarded as it was too difficult to control the foaming which inevitably accompanies the operation. If the distillation is done rapidly with a large free flame which also heats the delivery tube, this can be readily done by removing the flame and increasing the pressure judiciously from the stop-cock of the safety bottle when the melt appears to be about to run over, and when it has subsided distillation can be continued.

The advantages of this apparatus are as follows:

(1) The pure dehydrothiitoluidin can be easily removed by running hot alcohol through the delivery tube into the receiver by means of a rubber tube inserted into the neck of the distillation flask, which loosens it up, and it can then be broken up by shaking, and careful manipulation of a glass rod, and taken out.

(2) The apparatus can then be readily cleaned by soaking in hot concentrated sulphuric acid and so can be used repeatedly.

(3) The product obtained is pure and in good quantity, and the decomposition which accompanies the distillation can be controlled as all parts of the apparatus are accessible at all times.

(To be Continued.)

ISOTOPES OF TIN.

By F. H. LORING.

Dr. F. W. Aston announces in a recent issue of *Nature* (June 24th, 1922) that he has succeeded in determining what appear

to be *all* the isotopes of tin, by increasing the sensitiveness of the photographic plate used, there being no fewer than *eight* of these masses, viz.:—116, 117, 118, 119, 120, 121, 122, 124. Using two of the xenon lines for comparison, the tin isotope (120) contained in the compound SnCH_3 (=135) does not fall exactly midway between the xenon lines 134 and 136, thus indicating that this isotope is apparently a departure from a whole number. Aston states that all the tin values deviate perceptibly from integers by about a quarter of unity; so that taking the highest-mass isotope of the series, its mass might be *about* 123.75—to give an illustrative figure.

This appreciable departure from the integer value exists for *all* the other tin isotopes since their step-wise spacing is by *accurate* whole-number units measuring from the test value above. We are here reminded of Prof. Soddy's statement (*Chem. Soc. Proc.*, 1911, 99, p. 72), namely:—"The question naturally arises whether some of the common elements may not, in reality, be mixtures of chemically non-separable elements in constant proportions, differing step-wise by whole units in atomic weight. This would certainly account for the lack of regular relationships between the numerical values of the atomic weights." It will be seen how accurately this statement fits the present case of the tin isotopes.

The present writer was one of the first, if not *the* first, to develop along isotopic lines the strictly whole-number idea for the atomic weights and, with the exception of the tin isotopes, practically all the values thus far recorded have turned out to be whole numbers*without appreciable decimal fractions, and in a number of cases the values given from time to time in these columns have been afterwards found to exist by the improved positive-ray methods. My values for tin were, however, 116 and 121 only. A few illustrative examples may be of interest. The values found by Dempster (see Aston's book, "Isotopes," 1922) for magnesium are 24, 25 and 26, while my previously stated values were 24 and 26.

My later prediction in the case of potassium was isotopes 39 and 41, which are exactly those found by Aston. Mercury is of interest in this connection, for the values were found to be (197-200), 202, 204; my values standing about symmetrically intermediate, thus . . . 199 . . . 203 . . . My values for zinc (64 and 68) compared

with Dempster's later values (see Aston's book, p. 148), 64, 66, 68, 70, would seem to suggest that 66 and 70 are hydrides (ZnH_2); but there are some cases in which hydrides are ruled out, so that one is not justified in arriving at any conclusion in this respect; and, of course, it would be unscientific to attach to hypothetical values any importance, though I must point out that my conductivity relations were remarkable chance coincidences if they do not approximate to some truth. My chlorine values 35 and 40 are not quite in agreement, as the actual isotopes turned out to be 35 and 37. My articles in this journal for the past eight years show many close and exact predictions, but there were some failures. Of course, the credit undoubtedly belongs to the experimentalists; but it is not so easy as some might imagine to speculate and get close to the truth. It sometimes happens that the experimentalist is a poor speculator, and conversely the speculators are sometimes poor experimentalists; only in my case I have done a considerable amount of experimental work, but it does not happen to be in pure science. To experiment in pure science is *luxury work*, and few can afford to do this. Successful experimentation in this field is nevertheless exceedingly difficult, and an enormous amount of labour with patience is required, to say nothing of the highly-technical knowledge needed as a necessary equipment.

Returning to the question of the tin isotopes, the departures from integers raise important issues. Are these departures due to some peculiarity of the atoms or molecules in connection with Aston's deflection method? Or, do these departures involve *real* fractional masses of appreciable magnitude? Cesium has apparently only one value, 133, yet the atomic weight obtained by the chemical method of analysis is 132.81. Perhaps this value will turn out to be 132.75 (say) to harmonise with the tin values. On the other hand, an additional lower-mass atom may be revealed by the use of more sensitive plates, in which case 133 may be a whole number without an appreciable decimal fraction. We may expect to hear of more isotopes being discovered now that an improvement in the photographic plate, as applied to this work, has been made.

It is of passing interest to note that the lead isotopes, including those of radio-active

origin, would probably be about equal in number to those of tin. Has there been some disintegration process that is now completely finished and which has left as its only heritage seven tin isotopes? If this speculation should prove true, perhaps nearly all the isotopes are really due to a backward process, if I may so describe it. That is to say, if the atoms produced by such a process could be eliminated from the complete list, there would be no isotopes in the duplicate or multiple sense of the term. Whatever may be said, the subject is full of interest experimentally and speculatively, for we live in an age of great activity in both fields, and no doubt there are many surprises in store.

THE SOLUBILITY OF POTASSIUM FERROCYANIDE.

By REECE H. VALLANCE, M.Sc., A.I.C.

A paper has recently been published by Fabris [Gazzetta, 1921, LI. (2), 374] on the solubility of potassium ferrocyanide between 0° and 100° C. The solubility of this salt, at temperatures up to 30° C. has engaged the attention of the writer for some considerable time, in view of the fact that results obtained by previous workers do not harmonise. For example, at 20° C., figures varying from 25 to 40 grams of $K_4Fe(CN)_6$ in 100 grams of water have been given [Seidell, "Solubilities," Crosby Lockwood, 1920], and even the most recently obtained results are not concordant, as the following table shows:—

Grams $K_4Fe(CN)_6$ in 100 grams saturated solution.		Authority.
Temperature, °C.		
25	24.24	Wagner, Zeitsch. physikal. chem., 1910, 71, 428.
25	25.53	Grube, 1914, vide Seidell's "Solubilities," 1920.
25	19.87	Harkins and Pearce, J. Amer. Chem. Soc., 1916, 38, 2714.
20	21.80	Briggs, Trans. Chem. Soc., 1911, 99, 1019.

This disagreement in results seems to have been largely due to errors in the method of estimating the amount of salt in

the solution. The writer believes that he has been successful in overcoming this difficulty by using a new method of estimation, details of which will be published in due course. A series of determinations has been made at temperatures between 7° and 25° C., as shown in the accompanying table:—

Temperature. Solubility—grams $K_4Fe(CN)_6$
°C. in 100 grams saturated solution.

	Vallance.	Fabris.
10.4	17.541	17.95 (10°)
13.8	19.067	
16.9	20.862	
20.4	21.953	
23.1	23.074	23.36 (23°)
25.0	23.971	

Evidence has been obtained of a transition point in the neighbourhood of 18° C., but this has yet to be confirmed.

It had not been the intention of the writer to publish these results yet, but the communication by Fabris rendered this desirable.

*Municipal Technical School,
Birmingham.*

ABIETIC ACID AND METAL ABIETATES.

The preparation of abietic acid from rosin is described in the above paper by L. L. Steele (*Jour. Amer. Chem. Soc.*, 1922, p. 1333). The sample, in small lumps, is boiled under reflux with 98 per cent. acetic acid for 2 hours, and the solution filtered while hot through a pleated filter. The acid crystallised out overnight on standing in the cool. The crude acid is best recrystallised from glacial acetic acid. The acid, recrystallised three times from alcohol gave, in alcoholic solution (10 gm. per 100 cc.s) $[\alpha]_D^{20}$ -80.0°, and had an iodine valued at 0° C., 152.95 (mean); at 22-23° C., 168.55 (mean), at 25°-26° C. 169.8 (mean), the theoretical value being 167.9. The acid value of the acid (M.P. 161° to 165° C.) was 186.0 that for a mono-basic acid $C_{20}H_{30}O_2$ being 185.6. A number of metallic salts of abietic were next prepared, by adding the aqueous solution of the metal salt to one of sodium abietate. Thus, lead abietate, $Pb(C_{20}H_{29}O_2)_2$; Manganese abietate $Mn(C_{20}H_{29}O_2)_2$; the chromium and iron salts both contained an excess of abietic acid, but more successful results were obtained by using alcoholic solutions.

PROCEEDINGS AND NOTICES OF SOCIETIES.

ROYAL INSTITUTION.

A General Meeting of the members of the Royal Institution was held on Monday afternoon (July 3). Sir James Chrichton-Browne, Treasurer and Vice-President, in the chair. Viscountess D'Arey, Miss E. Fairfax, Sir Thomas Fisher, K.B.E., Mrs. Grove-Hills, Mr. J. Hetherington, Mr. A. J. Lambert, Mr. W. F. Roch, Captain Riall Sankey, C.B., Lieut.-Colonel J. A. Stirling, D.S.O., M.C., and Mr. C. Tierney were elected members. The death of the Prince of Monaco, an honorary member of the Institution, was announced, and a resolution of condolence was passed.

MINERALOGICAL SOCIETY.

June 27.

Dr. A. Hutchinson (President) in the chair.

A. BRAMMALL and H. F. HARWOOD: *The Dartmoor Granite; its accessory minerals and petrology.*

Minerals of general occurrence: tourmaline, ilmenite, magnetite, apatite, monazite, garnet, zircon (1) in water, clear, small crystals; (2) in tawny, zoned, larger, and more abundant crystals, pyrites and pyrrhotine. More restricted: fluor (colourless, blue and purple), topaz, cassiterite, andalusite, sphene, anatase, barytes. Biotite is abundant; muscovite is scanty. Streams have yielded, in addition, rutile, brookite, and blue-green anatase. Analyses are given of granite types (bulk), biotite, porphyritic feldspars (baryta-bearing), and some accessory minerals. The tor area (Haytor-Widecombe) is mapped to show that the granite occurs as successive sheets or flows, differing appreciably in chemical composition. Texture becomes coarser, porphyritic feldspars become more abundant and richer in plagioclase content, percentage of biotite and accessories increases with vertical descent in a flow. The relationship of topography to pseudo-bedding, jointing, veining and probable faulting is discussed.

W. F. P. McLINTOCK and F. R. ENOS: *On the Structure and Composition of the Strathmore Meteorite.*

A description is given of the microscopical characters as seen in thin sections of this meteorite, stones of which fell in Perthshire and Forfarshire on December 3, 1917. The structure is that of the intermediate chond-

rite group (Ci). An apatite-like mineral is present. Detailed chemical analyses of the magnetic and non-magnetic portions agree closely with the Baroti group.

HENRY F. COLLINS: *On some Crystallised Sulphates from the Province of Huelva, Spain.*

Analyses are given of pisanite, chalcantite, coquimbite, copiapite, voltaite, roemerite, etc., from various pyrites mines. Experiments were made to determine the range of miscibility of iron sulphate and copper sulphate in mixed crystals of pisanite ($\text{RSO}_4 \cdot 7\text{H}_2\text{O}$) and chalcantite ($\text{RSO}_4 \cdot 5\text{H}_2\text{O}$).

HAROLD HILTON: *The Graphical Construction of the Constants of a Shear.*

A graphical construction, based on the gnomonic projection, is given for obtaining the two circular planes of a shear, when the initial and final positions of two crystal poles or edges are known.

HAROLD HILTON: *A Note on Crystallographic Notation.*

A notation is suggested for the 32 crystal classes and the 230 groups of movements, which is easy to write and print, and is based on the fundamental principles of structure-theory.

A. F. HALLIMOND (with Chemical Analysis by E. G. RADLEY): *On Glauconite from the Greensand near Lewes, Sussex; the constitution of Glauconite.*

A boring through 325 feet of Gault at Iford Manor yielded glauconite sand. A discussion of the analysis of this material and of some previously published analyses leads to the formula $\text{R}_2\text{O} \cdot (4\text{R}_2\text{O}_3, \text{RO}) \cdot 10 \text{SiO}_2 \cdot n \text{H}_2\text{O}$.

L. J. SPENCER: *Ninth list of New Mineral Names.*

BOOK RECEIVED.

SIR EDWARD THORPE, C.B., LL.D., F.R.S. *A Dictionary of Applied Chemistry*, Vol. III. Pages: VI. + 735. Longmans, Green & Co., 39, Paternoster Row, E.C.4., 1922. Price £3 net.

NOTICES OF BOOKS.

The Calculations of Analytical Chemistry, by EDMUND H. MILLER, Ph.D. Pp. X + 201. Third edition. London & New York: The MacMillan Company, 1921. Price 9s.

Prof. Miller's useful compilation of the calculations of data and results in analyti-

cal and general chemistry and students' exercises thereon, has now reached its third edition.

The calculations include those of the Equivalents, Atomic Weights and Formulæ, Volumetric and Gravimetric Analysis, and Thermochemical and Electrochemical data. The examples are preceded by brief descriptions and the exercises are typical ones. Some of them have been taken from important original papers.

Numerous Tables of Chemical, Physical and Mathematical data are given at the end. (A more recent Table of Atomic Weights than that of 1904 might have been inserted.)

Chemical calculations frequently receive less attention in schools and colleges than they should, therefore Prof. Miller's book merits the careful attention of lecturers and science masters.

J. G. F. D.

Metallography, by C. H. DESCH, D.Sc. (LOND.), PH.D. (WÜRZB). Pp. XI. + 440 + 14 plates. Third Edition. London: Longmans, Green & Co., 1922. Price 16s. net.

Prof. Desch's book on Metallography, i.e., the physical and microscopical study of the internal structure of metallic alloys, has reached its third edition.

The text has been extensively revised, and the subject matter has been brought up-to-date by the incorporation of the recent results obtained in this branch of physical chemistry, especially in connection with corrosion and the metallography of iron and steel. The numerous photo-micrographs illustrating the internal structure of alloys, diffusion of metals, etc., are especially good.

The binary and ternary systems for which equilibrium diagrams have been published are collected in the useful appendix, with the latest references of accurate work in each case.

This volume, which is one of the Text-books of Physical Chemistry edited by the late Sir William Ramsay and Prof. F. G. Donnan, is deservedly popular, and the present edition will not only be extensively used as a textbook by students, but will also be freely consulted by those who desire information on this subject, which has recently attained considerable importance.

Metallic Alloys: Their Structure and Constitution, by G. H. GULLIVER, D.Sc., F.R.S.E., A.M.I.MECH.E., M.INST.M. Pp. XXVIII. + 439. Fourth Edition. London: Charles Griffin & Co., Ltd., 1921. Price 15s.

The author has described fully the methods for preparing and studying binary and ternary alloys. Various points of theoretical interest are discussed with the help of numerous equilibrium diagrams. The chapter on the microscope in engineering practice is interesting and important.

This edition is substantially the same as the previous one, except that an appendix on the effect of the rate of cooling upon the constitution of binary alloys has been added.

In the preface it is stated that the text is undergoing revision, and that the present edition has been issued to meet the present need for copies of this valuable work.

Modern Microscopy, by M. J. CROSS and MARTIN J. COLE. Pp. X. + 315 + 12 plates. Fifth edition. London: Baillière, Tindall & Cox, 1922. Price 10s. 6d. net.

In this book on Microscopy, revised and re-arranged by H. F. Angus, it is clearly demonstrated that the microscope has been of great service to Science in the elucidation of new facts and in the clear perception of fine structure.

Part I. gives a detailed account of the construction of various microscopes and accessories, with full instructions for their use. A list of Microscopical Societies and Clubs with their Rules is also included in this section.

In Part II., chapters on the uses of the microscope in special subjects have been contributed by various authorities. That on its service in the interests of Public Health, by Dr. W. E. Cooke, is one of the most important, and indicates how analysts are dependent upon microscopical as well as chemical evidence in forming their conclusions. On p. 104 it is stated that in populous districts the staggering total of three million solid particles may be counted in one cubic inch of air. This may include fibres of wool and cotton, mineral dust, and especially numerous micro-organisms, many of them dangerous ones.

Part III. constitutes a popular exposition of the study of various branches of Natural History with the aid of the microscope. In this eminently practical section, complete

details are given for the preparation of slides and the mounting of objects for examination.

The present edition of this handbook has been written more especially for beginners and students, but much of its contents cannot fail to interest more advanced workers.

J. G. F. D.

Modern Chemical Lecture Diagrams. by DR. GEOFFREY MARTIN, D.Sc., etc., assisted by J. M. DICKSON, B.Sc., and MAJOR J. W. CRISTELOW, B.Sc., A.I.C. Pp. 88. London: Sampson Low, Marston & Co., Ltd., 1922. Price 3s. 6d.

The author does not divulge his object in publishing this little book, but presumably it is intended for the use of the students of those lecturers who employ Dr. Martin's large charts of Chemical Lecture Diagrams.

In general, these diagrams are good, and convey a fair idea of the nature of various processes, but that of Pietet's method for liquefying gases, on p. 14, is not at all clear, and the Vapour Density apparatus, p. 20, has lost in clearness by reduction.

Mendeléeff's name is spelt with one f on p. 59, elsewhere it has two. It also seems incongruous to find together on p. 12 the Solubility Curves of Salts and Carbon Dioxide Isothermals.

Lecturers who have used Dr. Martin's Charts will find the present volume useful for reference, and their students will be more easily able to write up their lecture notes with the help of its descriptions.

J. G. F. D.

ERRATUM.

Calcium oxalate in *Acacia Cambagei*. C.N. CXXIII., p. 315. Table of analyses, figures in fourth and fifth lines should be transposed.

A CHEMICAL STUDY OF DOLOMITES.

By LAWRENCE R. MCKAY AND WILLIAM A. MOORE.

An ideal dolomite, calcium magnesium carbonate, would consist of calcium carbonate, 54.35 per cent., and magnesium carbonate, 45.65 per cent. Possibly such a dolomite has never been found in nature.

The rocks of north-eastern Iowa are dolomites and fairly typical. The analysis of a

specimen from near Mount Vernon, Iowa, resulted as follows:—

SiO ₂	0.86%
Fe ₂ O ₃	0.60%
Al ₂ O ₃	0.54%
CaCO ₃	54.35%
MgCO ₃	43.65%

100.00%

1. Specimen from Little Falls, New York. Light grey in colour and uniform throughout.

SiO ₂	3.96%
Fe ₂ O ₃ and Al ₂ O ₃	0.62%
CaCO ₃	55.12%
MgCO ₃	40.44%

100.44%

The specimen is a fairly typical dolomite. The specific gravity is 2.84.

2. Specimen from Kasota, Minnesota. The colour throughout the mass is light yellowish brown.

SiO ₂	9.08%
Fe ₂ O ₃ and Al ₂ O ₃	0.91%
CaCO ₃	51.80%
MgCO ₃	38.64%

100.43%

The rock approaches a dolomite. The specific gravity is 2.72.

3. A specimen from Freiberg, Saxony. A yellowish-grey crystalline deposit on quartz. The analysis shows it cannot be called a dolomite, nor even a limestone.

SiO ₂	26.60%
Fe ₂ O ₃	51.41%
CaCO ₃	4.46%
MgCO ₃	17.54%

100.01%

The specific gravity of the entire rock, the crystalline deposit, and the quartz together is 3.52.

Ten specimens from the Austrian Tyrol, the locality where Deodat Dolomieu first studied dolomite rocks and made known their composition.

1. Specimen from Martinswand, Tyrol, Austria. A compact, crystalline, greyish-white variety.

SiO ₂	0.10%
Fe ₂ O ₃	1.70%
Al ₂ O ₃	0.00%
CaCO ₃	49.71%
MgCO ₃	48.53%

100.04%

2. Specimen from Andrian Ueberetsch, Tyrol, Austria. White, granular, resembling marble.

SiO ₂	0.10%
Fe ₂ O ₃	0.58%
Al ₂ O ₃	0.00%
CaCO ₃	54.45%
MgCO ₃	44.84%

99.97%

The specific gravity is 2.71 per cent. The specimen is almost a typical dolomite.

3. Specimen from Grossachenthal, near St. Johann, Tyrol, Austria. A grey, compact, non-crystalline variety.

SiO ₂	0.20%
Fe ₂ O ₃	0.85%
Al ₂ O ₃	0.00%
CaCO ₃	53.62%
MgCO ₃	45.31%

99.98%

This is an unusually perfect dolomite. The specific gravity is 2.84.

4. Specimen from St. Martin, Tyrol, Austria.

SiO ₂	0.20%
Fe ₂ O ₃	0.60%
Al ₂ O ₃	0.00%
CaCO ₃	51.91%
MgCO ₃	47.52%

100.23%

This is a pure white crystalline variety, resembling marble. The analysis shows it to be almost a true dolomite. The specific gravity is 2.80.

5. Specimen from Mauknerbach, Tyrol, Austria; a pink, massive variety, of a pearly lustre, but also containing transparent crystals.

SiO ₂	0.48%
Fe ₂ O ₃	0.35%
Al ₂ O ₃	0.00%
CaCO ₃	53.21%
MgCO ₃	45.81%

99.85%

The specific gravity is 2.75. It is a fairly typical dolomite.

6. Specimen from Pinégal, near Bozen, Tyrol, Austria. It is a pure white crystalline rock resembling marble. The specific gravity is 2.70.

SiO ₂	0.70%
Fe ₂ O ₃	0.60%
Al ₂ O ₃	0.00%
CaCO ₃	84.03%
MgCO ₃	14.76%

100.09%

The specific gravity is 2.70. The specimen is not a dolomite but a magnesian limestone.

7. Specimen from Sonnenvendjoch, Tyrol, Austria; a compact, massive, greyish rock.

SiO ₂	3.58%
Fe ₂ O ₃	3.18%
Al ₂ O ₃	0.00%
CaCO ₃	73.75%
MgCO ₃	19.59%

100.07%

The specific gravity is 2.74. The specimen is not a dolomite, but a magnesian limestone.

8. Specimen from Reiterkogel, near Brixlegg, Tyrol, Austria. It is a greyish-white, crystalline, compact rock.

SiO ₂	0.35%
Fe ₂ O ₃	3.40%
Al ₂ O ₃	1.85%
CaCO ₃	52.01%
MgCO ₃	42.52%

100.13%

The specific gravity is 2.80. The rock is a fairly typical dolomite.

9. Specimen from Zirler Klamm, Tyrol, Austria. It is a black, massive, compact, heavy rock, and bears a resemblance to quartz.

SiO ₂	14.50%
Fe ₂ O ₃	9.50%
Al ₂ O ₃	7.00%
CaCO ₃	48.55%
MgCO ₃	20.39%

99.94%

The specific gravity is 2.80. The rock approximates a magnesian limestone in composition.

10. Specimen from Kloster Alp, Tyrol. It is a grey, compact, massive, hard variety, one side of which seemed to have been fused.

SiO ₂	0.75%
Fe ₂ O ₃	4.30%
Al ₂ O ₃	3.00%
CaCO ₃	85.73%
MgCO ₃	6.19%

99.97%

The specimen is a magnesian limestone. The specific gravity is 2.70.

Cornell College, Mount Vernon, Iowa.

CHEMICAL NOTICES FROM FOREIGN SOURCES

NEW PROPERTIES OF GREEN CHROMIUM SULPHATE.—*A. Recoura.* Green chromium sulphate can exist in a condensed form, and it is then capable of forming complexes with an enormous number of molecules of metallic sulphates. These complexes are very unstable, one factor influencing their stability being the acidity of the solution which prevents hydrolysis, and another and more important factor being the concentration of the solution. There seems to be a very great difference between the properties of the condensed complex $[\text{Cr}_2 \cdot 3 \text{S O}_4]_2$ and those of the simple complex, but the author has not yet succeeded in determining the physical constants of the liquids containing them. (*Comptes Rendus*, CLXXIV., 1922, 1460.)

FURFURAL α -METHYLCYCLOHEXANONE AND SOME OF ITS DERIVATIVES, AND THE MONO AND DIFURFURALCYCLOHEXANONES.—*N. Wolff.*—When furfural acts on α -methylcyclohexanone yellow crystals are obtained, to which the formula $\text{C}_{12}\text{H}_{14}\text{O}_2$ can be assigned. When this compound is subjected to reduction by sodium amalgam, two atoms of hydrogen are fixed at the double bond and the reduction compound which is a yellow oil, has the formula $\text{C}_{12}\text{H}_{16}\text{O}_2$. When the original compound is treated with organo-magnesium compounds, bromides of phenyl and *p*-tolylmagnesium, it combines with these organic radicals to give phenyl and *p*-tolyl α -methylcyclohexanone methanes. The condensation of furfural with cyclohexanone in the same conditions gives two different derivatives, mono and difurfuralcyclohexanone, which can easily be separated by fractional distillation or by their very different solubilities in ether, alcohol and petroleum ether. (*Comptes Rendus*, CLXXIV., 1922, 1469.)

CRYSTALLISATION OF AMORPHOUS TELLURIUM.—*A. Damien.*—Two theories have been put forward as to the nature of amorphous substances. According to one they are in a metastable condition, their velocity of crystallisation being zero, while according to the other theory, at a given pressure the crystalline state is limited to low temperatures by the amorphous solid state which are thus stable, just as it is at higher temperatures by the liquid state. The

author has studied the allotropy of tellurium in order to throw some light upon these theories. Tellurium was treated with a solution of bromine in concentrated hydrochloric acid, and it was found that crystallised tellurium is attacked very rapidly, while amorphous tellurium is instantaneously dissolved. The heat of reaction was determined in each case, and it was found that, however crystallised tellurium had been prepared, the heat of reaction was the same and decidedly lower than that of amorphous tellurium. The irreversible reaction can always be expressed by the equation:

$\text{Te amorphous} = \text{Te crystallised} + 2.63 \text{ cal.}$
Thus amorphous tellurium appears to be a metastable form for which all the temperatures at which the element is solid are lower than that at which it is stable.—(*Comptes Rendus*, CLXXIV., 1922, 1548.)

PREPARATION OF DIALKYLVINYL CARBINOLS.—*R. Locquin and Sung Wouseng.*—The dialkylethynyl carbinols can be hydrogenated in presence of reduced nickel to give ethylenic or vinyl alcohols which are mobile liquids boiling at about the same temperatures as the corresponding tertiary alcohols. They form more or less stable hydrates with water. They possess all the characters of tertiary alcohols. They cannot be etherified satisfactorily, but they readily give crystallised allophanates.—(*Comptes Rendus*, CLXXIV., 1922, 1551.)

SOME NOTES ON THE BEHAVIOUR OF LEAD ACETATE TOWARDS POTASSIUM DICHROMATE UNDER DIFFERENT CONDITIONS.

By GEOFFREY N. RIDLEY.

Experiments show that the behaviour of lead acetate with potassium dichromate is affected by alteration of the conditions under which the two compounds react. The most important conditions are those in which the changing of the liquid or solvent is involved; a liquid must, of necessity, be used if the precipitation is to be examined.

Heat often tends to bring about coagulation of the particles of a precipitate, the actual extent to which any precipitate is affected depends upon its composition. The precipitated lead chromate is only affected in this direction to a small extent when

thrown down from an aqueous solution of the dichromate at 50° C., but upon being stirred and allowed to settle, the precipitate is in a moderately fine state of division. The precipitate is finer when thrown down from a *weak* aqueous solution at room temperature, than that deposited from a *strong* solution under the same conditions. It is conceivable that the ionic state may have some influence here; it is, however, open to doubt. (For the purpose of examining the precipitates microscopically, a low power objective was found the most suitable as giving a larger surface than a high power objective).

Alteration is made in the speed of precipitation by utilising different solvents for the lead acetate and potassium dichromate. Aqueous solutions of these salts are employed in analysis, in which case the precipitation is rapid and the deposit dense. If, however, clear alcoholic solutions are used, the rate of deposition is reduced to a considerable extent and the precipitated chromate only appears as a slight deposit which makes the liquid more or less turbid. Upon the addition of a little water the lead chromate is rapidly thrown down in the normal way.

In this case the reagents are only ionised to a comparatively small degree, and therefore the precipitation value is not so great as that reached by the use of aqueous solutions. The introduction of water increases the ionisation and the chromate is deposited in the usual manner.

The addition of an alcoholic solution of the dichromate to a solution of lead acetate in glycerol likewise gives only a slight precipitate. Here, again, the reaction is advanced by the addition of water, as shown by the voluminous yellow lead chromate which is produced in the solution when the water is added.

In the case where carbon disulphide is used, the results are indicative of the total inactivity of the liquid. A mixture of the finely powdered compounds, when treated with carbon disulphide, is not affected by the addition of this liquid, and hence no precipitate is formed. No signs of chemical action are observed. For the purpose of causing the dichromate and the lead salt to react, water is always added—the aqueous solution is always used. Hence the water acts as a kind of “link” by which the two compounds are in a position to react. The carbon disulphide does not function as a “link,” hence the absence of chemical action.

THE INSTITUTION OF MINING AND METALLURGY. - PRESIDENTIAL ADDRESS

(Delivered at the recent Annual General Meeting).

By S. J. SPEAR, A.R.S.M.

It is the privilege of a President when assuming office to give an address upon any subject that may interest him, without previously submitting his intended remarks to his colleagues on the Council. I hope that I shall not abuse the latitude thus allowed me if I speak on matters concerning the welfare of the Institution instead of some non-controversial subject. I was present at the meeting held at Winchester House in 1892 when the Institution was founded, and I feel that I cannot avoid contrasting the situation then with what it is now, and with what it perhaps ought to be. Hence my remarks this evening will be concerned mainly with the work that the Institution has already accomplished, and with what still remains to be done.

Thirty years ago, the so-called practical miner or smelter was regarded by many people as the most suitable man to place in charge of mining or metallurgical operations. The development of the Witwatersrand Goldfields was no doubt an important factor in the education of the public in mining and metallurgical matters, and towards a better appreciation of the trained engineer. Under the conditions of those days, it is readily understandable that properly-educated mining engineers and metallurgists were not regarded by the general public as professional men in the same sense as they regarded lawyers and medical men, for there was no marked line to enable discrimination between professional and practical mining engineers.

One of the objects of our Institution has been to make clear the distinction between the educated engineer and the so-called practical one, and this has been so far accomplished and become effective that the latter type is rapidly becoming extinct. Civil engineers, mechanical engineers and electrical engineers have in general gained more in public esteem than mining engineers; perhaps mainly because their work is more visible to the average person. We must also recognise that as mining is a business and as mining engineers, besides their professional duties, usually direct also the commercial side of the businesses, they

are often more closely connected with financial transactions than perhaps any other class of engineer, with the result that the professional status of mining engineers is liable to be somewhat dimmed. Our Institution, however, concerns itself only with the technique and economies of the mining industry, and as a body is purely professional and only indirectly concerned with the financial side of the industry.

PROFESSIONAL STATUS.

During the past 30 years it has been the endeavour to attract to the banner of the Institution all suitably qualified men who wished to live up to a truly professional standard; but without solicitation or propaganda. President Cox in 1899 said: "I hope in the not distant future, all mining and metallurgical engineers of standing throughout the world will have become enrolled as members." In his Presidential address in 1913, Bedford McNeill said: "I hold no one should be permitted to style himself a mining engineer unless he is qualified to do so, and of his qualifications for mining other than coal, this Institution ought to be the tribunal. . . . What we wish to do is to protect the public on the one hand, and on the other secure an honourable career for ourselves."

In so far as British engineers are concerned, we have now almost reached the stage when we may stigmatize as quacks all those who do not belong to the engineering institution that represents the particular branch of engineering they profess. As you are all aware, our Institution does not represent all classes of mining engineers or metallurgists, but fortunately the most important of the Institutions representing the other classes hold similar views to our own regarding professional standards.

It may therefore soon be possible, in conjunction with such other Institutions, effectively to control the members of the two allied professions. Other Engineering Institutions besides those representing Mining and Metallurgy also suffer from the abuse of the descriptive title "Engineer," and recent events, in which our Institution has taken some part, point to the probability of the formation of a General Engineering Council, which will, amongst other things, take steps to protect all properly-qualified engineers and correlate the work of the several existing engineering societies. A combination of such a kind would attain its objects more effectively than any Insti-

tution could otherwise do singly, and, moreover, in these days of political strife it is most desirable that all professional men should combine for self-protection.

The closer association with the Institution of Mining Engineers that we have recently entered into will no doubt prove of considerable advantage in raising the status of British Mining Engineers in general. Both being chartered Institutions, the public cannot be expected to discriminate between the two, and accordingly both should aim at achieving the same standards of qualification and conduct. That is, I believe, the spirit now animating the two Institutions, and there is every prospect of its being accomplished very rapidly.

PROFESSIONAL CONDUCT.

Under its Constitution the Institution possesses authority to expel a member for unprofessional conduct, and that such expulsions are infrequent is probably due to the careful scrutiny of candidates before admission into the Institution. During the past, many members have asked the Council to formulate rules tending towards a uniform standard of ethics amongst its members. The difficulty of framing a detailed code is that it might imply some disregard of the ordinary principles of honesty and integrity by our members.

What, perhaps, is better than any code that could be drafted, was expressed by W. McDermott in his Presidential Address of 1897: "In view of the peculiar difficulties and temptations of a mining engineer, I think every school of mines should have a department of ethical culture included in the regular course . . . to strengthen the conscience of the student before he is turned loose." Mr. McDermott probably with intention mentioned only the mining engineer, because the metallurgist during his career does not encounter so many of the difficulties referred to.

The student could, I think, also be warned of the pitfalls that may trap the innocent. For example, there is nothing inherently dishonest in owning shares of a mine in which one may be employed; indeed, the idea of workers becoming shareholders is often recommended as a remedy for industrial unrest. It is, nevertheless, very undesirable for an engineer occupying a responsible position on a mine to deal in its shares, because he will probably be suspected of using his information before the other shareholders obtained it. No special

code of ethics is needed to tell a man that it is wrong to misuse the confidence placed in him; but, on the other hand, he should not be specifically forbidden to do a thing which is perfectly honest if done honestly.

Similarly in the case of a mining engineer receiving a percentage of profits; some employers desire such a method of payment, as being likely to create the best results; in later years the engineer, however, may find himself wrongfully accused of neglecting development and maintenance work for the sake of his share of profits.

Though the Institution might usefully point out to its members some of the dangers they may encounter, it would surely be undesirable to forbid a member any transaction, which was honest in itself, for it would pre-suppose that our member could not otherwise perform it honestly.

The matter of "contingent fees" is in some respects a different matter from the two examples I have just given. The simplest and worst form of this, is for an engineer examining a mine to take part-payment of his fee in shares of a company that is to be formed. Young engineers are not supposed to undertake such examinations, and the older ones, who do, are presumed to know the dangers of such procedure.

Every cautious engineer before undertaking an examination, insists on a considerable payment in advance, and the balance on handing in his report, for he knows that in the event of an adverse report, the same will be worse than useless for the objects of an unscrupulous promoter. The latter will often decline to pay for the report and will trump up every possible charge against the engineer in the endeavour to show that the report was unreliable.

Though the Institution has no written code of ethics, any complaints against its members are brought before the Council, consisting of men of experience, and most surely they would regard with grave suspicion any member who had accepted a contingent fee for a report. They would be inclined thereby to believe that any other charges of misconduct brought against him were probably true. Another aspect of the matter is that anyone undertaking work for contingent fees thereby injures his fellow engineers who demand proper payment for their services.

TECHNICAL EDUCATION.

The Institution has from its commencement attached much importance to scienti-

fic and technical education. I need hardly remind you of what it has already done to assist the training of Post Graduate Students. The value we have placed upon a sound education has always been shown by the conditions of admission to Associateship, and more recently by arranging under our new By-laws that before long it will not be possible for anyone to become a full Member who has not had a suitable scientific training. By maintaining our qualifications for admission at a high level, we hope that future generations of mining engineers will be freed from many of the difficulties the present generation has encountered, and that whilst assisting to secure a suitable reward for them the more stringent qualifications will also improve the status of the mining industry in general.

In the matter of technical education our Institution has played a prominent part in connection with the Imperial College of Science and Technology, more especially in matters concerning the Royal School of Mines. Our desire from the first has been to see that College recognised as the technological centre of the Empire, which would attract graduates from other colleges and universities throughout the Empire for courses of advanced training and research. Last year there were 52 full-time students at the College who came from the Overseas Dominions of the British Empire.

The work of the College must necessarily be hampered so long as it possesses no power to grant degrees. It is only natural that many students, after graduating at a Dominion University, will feel that they cannot afford the expense of a year's post-graduate course in London unless they can thereby obtain some special hall-mark. Our Institution has already advocated that the status of the College should be raised to that of an Imperial University of Science and Technology. There exists, however, powerful opposition to this proposal, mainly from two sources. First from the University of London, which would naturally like to absorb others in order to strengthen itself, though failing to see the undesirability of a county institution absorbing an Imperial one. We cannot expect a graduate of one of our famed Colonial Universities to be particularly enamoured of a London University degree; therefore any facilities that might be offered to students of the Imperial College to obtain London degrees, would not meet the case.

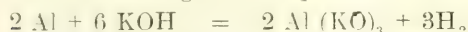
There are other important objections to absorption of the Imperial College by the University of London, and our Council so long ago as 1914 stated that it was their deliberate opinion that the Imperial College could not possibly achieve the principal purpose for which it was founded, if it became absorbed by the University of London.

The more difficult opponents to be combated are those who have themselves been educated on the classical side of existing Universities. No doubt to them a University of Science and Technology, or indeed any University specifically limiting its teaching to any particular branch of knowledge, is unthinkable. We can respect the views of these opponents, notwithstanding their impracticability for present-day needs, for we do not underrate the value of the older forms of culture. We do, however, protest against the suggestion that a study of the humanities is a higher form of education than a study of natural science. Where time or circumstances do not allow of a proper study of both, it is to be regretted that persons who received their educational training in Arts, with little or no Science, should offer opposition to others who place a greater value on Science, and cannot spare much time for Arts.

(To be Continued.)

DETERMINATION OF ALUMINIUM.

A new method for estimating the amount of aluminium in commercial samples is described by L. Losana in *Giornale di Chimica Industriale ed Applicata*. 0.5 to 1.0 gm. of the metal is heated with caustic potash solution in a flask through which a current of air is drawn. The hydrogen evolved, according to the equation:—



is first passed through a water cooled condenser into a drying tube containing pumice saturated with strong sulphuric acid. It is then passed through a tube of calcium chloride or phosphoric anhydride into a tube electrically heated to about 200° C. containing palladiumised asbestos. Here it combines with the oxygen of the air, which is continually drawn through the apparatus, and the water formed is collected in two weighed U tubes, one containing CaCl_2 and the other P_2O_5 . 1 gm. Al corresponds to 0.9964 H_2O . The amount of aluminium can then be calculated.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 16651 Baumgartner, E.—Manufacture of chromate of soda. June 15.
- 16687 Erikson, O.—Soda recovery process in sulphate paper-pulp manufacture. June 16.
- 16640 Hurter, A. Method of manufacture of alumina from sulphate of aluminium. June 15.
- 16197 Jacobson, B. H.—Process of making anhydrous metallic chlorides. June 12.
- 16528 Jones, T. R.—Process for manufacture of a zinc-oxide substance. June 14.

Specifications Published This Week.

- 160172—L'Air Liquide, Soc. Anon. Pour l'Etude et l'Exploitation des Procédés G. Claude.—Processes for the production of bicarbonate of soda and of ammonium chloride.
- 180837—Pike, R. D.—Method of treating magnesite.

Abstract Published This Week.

Hydrocyanic Acid; cyanides.—Patent No. 179096.—Messrs. Air Reduction Co., Inc., of 342, Madison Avenue, Manhattan, New York, U.S.A., have obtained a Patent in this country for a process of obtaining Hydrocyanic acid.

It is obtained from pure or crude cyanides by treatment with carbonic acid, without taking precautions to control the temperature, by removing the gaseous product so rapidly as to prevent polymerization. From one and a half to three times the theoretical quantity of carbonic acid, for example, may be passed through a layer of cyanide in from six to twelve minutes. A reaction vessel on trunnions is provided with a perforated metal false bottom, upon which are several layers of metal gauze covered by a sheet of porous material such as a moel metal filter cloth. The cyanide is ground, moistened, and placed in a layer upon the sheet. Carbon dioxide is supplied from a cylinder through a meter, and passes through the charge downwardly. The gases issue by a pipe and pass through coolers, and preferably a compressor to a coil in which the hydrocyanic acid is liquefied. The liquefied acid collects in a store tank and the uncondensed gas passes to a holder and thence returns to the reaction vessel by a pipe. The reaction chamber may be provided with a jacket for removing the heat resulting from the previous charge. The hydrocyanic acid may be absorbed in alkalis for the production of pure cyanides.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3249

THE BRITISH ASSOCIATION OF CHEMISTRY.

THE UNEMPLOYMENT BENEFIT FUND.

A Special General Meeting of the British Association of Chemists was held on Saturday, July 8th, at the Midland Hotel, Manchester, for confirmation of the Advisory Ballot on the Unemployment Benefit Scheme and for its formal adoption as part of the rules of the Association.

In the unavoidable absence of the President, the chair was taken by Mr. Wm. E. Kay, there being about 50 members present.

The occasion was noteworthy, having regard to the fact that copies of the first monthly issue of the official journal of the Association—"The Bulletin of the British Association of Chemists"—were distributed among those present. It contains an editorial, reports of proceedings from the London, Birmingham and Manchester sections, an article entitled "Educational Facilities for Laboratory Assistants," and an earnest appeal from a writer, giving the initials "F.B.G.," to all members to wholeheartedly support the establishment of the Unemployment Benefit Fund. Many chemists, he wrote, were now out of employment, and, to quote the writer's concluding words—"It may be your turn next."

The Chairman, in outlining the nature of the business to be transacted, said that an attempt was now being made to help, out of a common purse, those among them upon whom there were serious and urgent calls. Although they had taken the best professional advice they could, yet the Unemployment Benefit Fund Scheme was somewhat tentative in the sense that there was still very little known as to how unemployment among chemists stood in relation to general unemployment. There were no actuarial figures available which would give them the means of putting forward a cut-and-dried scheme. Therefore they had had to prepare one which had in it elements of elasticity, and they had endeavoured to prepare, under certain aspects of the scheme, means of meeting

special contingencies. In a preliminary way, the feeling of the members had been tested and had proved to be emphatically in favour of the establishment of a scheme. Only 14 per cent. objected to it. The course that he intended to pursue in the conduct of the meeting was to put before them two resolutions:

(1) "That this meeting confirms the result of the ballot on the Unemployment Benefit Fund Scheme, and hereby authorises the Council to proceed with its registration as an addition to the rules of the Association."

(2) "That the rules for the Unemployment Benefit Fund be put into immediate operation, and that subscriptions to the Fund be payable as from 1st July, 1922."

The Chairman then formally moved the first resolution.

Mr. Harrison, as Secretary of the Fund Committee, seconded. He thought they would all agree with him when he said that this was the greatest economic scheme which had ever been placed before chemists. The Council and the Committee which had been charged with its preparation had done their best to make it a success. It was one which should be part and parcel of the first ideals of the Association. No one could possibly have any objection to its principle. Their organisation was an economic body banded together for the purpose of looking after each other's interests. The scheme was not a stunt for councillors to seek reelection on, and it was not one by which any member could take advantage of another. It would benefit the Association in many ways, financially and socially, and he was convinced that in the future the fortunes of the Association would largely depend upon it. Most of them had noticed at some time or other some great commercial undertaking, which had been moving forward slowly, suddenly burst forth into great prosperity. When they came to consider why this was so, they found that it was due in the main to the accumulation of much capital. Speaking for themselves, they did not want to gain capital by increasing subscriptions, but by gaining members. If they gained members they would obtain all the capital they required, and without capital they could not go forward as an Association.

The new rules embodying the scheme were then considered in detail. They were 18 in number.

Dr. Foster enquired whether the scheme could be made applicable for probationers to voluntarily join it.

It was stated that, under the rules in their present form, this could not be done, but if thought necessary some provision could be made in that direction.

Mr. R. Brightman suggested that before dealing with any question of probationers they should obtain fresh actuarial advice.

Dr. Foster said that his question was merely intended to be suggestive, and the Chairman promised that the Committee would consider the point.

Rules 2 and 3 provide that the Fund shall be administered through a Special Purposes Committee appointed by the Council, and shall include the Trustees of the Association, and that the benefits paid shall be upon a "unit system" and shall vary in accordance with the number of units of contributions taken up.

Rule 7 was considered in the following form:—

(7) The maximum number of Units for which a Member may subscribe shall be dependent on age and in accordance with the following Schedule, except in the case of a married member, who may take up one extra Unit:

Age at joining.	Benefit per week for each Unit subscribed.	Maximum No. of Units for which a Member may subscribe.
21-30	20/-	3
31-40	20/-	4
41-46	17/6	6
47-60	15/-	6

Rule 8 was also considered in the following form:—

(8) Members ceasing to be employed in so far as their main employment is concerned, but who may be earning fees or other remuneration in respect to teaching or other part-time employment, either day-time or evening, shall receive benefits in accordance with the following scale:—

Earnings from part-time employment as above.	Rate of benefit payable.
--	--------------------------

Not exceeding 30s. per week. Full benefit.

Exceeding 30s. per week but not exceeding 50s. per week. Three-fourths

Exceeding 50s. per week but not exceeding 75s. per week. One-half.

Exceeding 75s. per week but not exceeding 105s. per week. One-fourth.

Exceeding 105s. per week. Nil.

Rule 10 provides that no benefits shall be payable during the first month of unemployment, and Rule 11 that in order to provide a nucleus for the Fund no benefits shall be payable during the first six months of the operation of the scheme. Members joining the Fund after the date of the Scheme first being put into operation will also not be eligible for benefit until six months from the date of their first subscription. Rule 13 makes provision for any member being suspended from benefit owing to his own misconduct.

Rule provides, after the auditors have certified that the necessary Reserve Funds have been established, that 75 per cent. of the surplus funds may be distributed as a cash bonus.

The whole of the Rules having been discussed, and necessary textual alterations having been made, they were confirmed in the terms of the first resolution.

The Chairman then moved, and Mr. Redgrove seconded, the adoption of the second resolution, which was carried unanimously.

A general discussion then took place in the course of which Mr. A. S. Mills gave an account of the working of the Unemployment Bureau and of the rebates which were now allowed by the Income Tax Commissioners in respect to damaged clothing, &c. Closer co-operation with the N.U.S.W. was also advocated.

NOTES.

The Library of the Chemical Society will be closed for stocktaking from August 7th to August 19th, and will close each evening at 5 o'clock from August 21st to September 16th.

In this week's *Manchester Guardian Commercial* is given a description of "Arghan," a new textile fabric for which much is claimed. Originally discovered in the leaves of a plant akin to the pineapple growing in the South American wilds, the difficulties of transport were at first in-

superable. So a large quantity of roots were conveyed to the Federated Malay States, where the F.M.S. Government, foreseeing the fibre's potential value, immediately set apart 30,000 acres for its development. Now the Ceylon and Indian Governments propose to grant similar large tracts. Arghan is past its experimental stages, since not only magnificent fibre, but a beautiful firm cloth is being made from it. No great preparation is needed, for the broad leaves, without any degumming or retting, split up into innumerable pearly white silky fibres. Their merits are astonishing, being actually 50 per cent. stronger than hemp, extending to six feet or more and adamant to sea-water. Both the cloth and the yarn take dye permanently, and it is opined by experts that if the fibre can be produced at lower cost than similar flaxen or hemp fabric, it must rival them in use.

Messrs. H. & K. Lewis & Co., Ltd., have sent a copy of their list of College Text Books and Works of Reference on Science and Technology for 1922.

The subjects are arranged in alphabetical order from Agriculture to Zoology, and include a very complete list of books on Chemistry, with dates and present prices.

The list can be obtained by application to the Publishers.

The summer issue of the *Chemist and Druggist* has just been published, and is a highly creditable production. In addition to a volume of matter of importance to the pharmacist, a large number of striking advertisement pages are given, some of striking originality.

DEHYDROTHIOTOLUIDIN: ITS ISOMERS, HOMOLOGUES, ANALOGUES, AND DERIVATIVES.

By MARTIN MEYER, B.Sc., M.A.

NEW YORK CITY.

(Continued from Last Week).

8. Preparation of Pure Dehydrothiotoluidin.

As a result of the work described, the following procedure for the preparation of

the pure compound was arrived at. This method, unlike any of the previous ones found in the literature, is complete as far as laboratory directions are concerned, will work exactly as recorded, and was used for the preparation of considerable quantities of the pure base.

110 g. of paratoluidin and 60 g. of powdered roll sulphur are heated from 4 to 6 hours in a one litre flask equipped with a reflux air condenser on an oil bath at 220°. At the end of this time the melt is poured out into an evaporating dish or a mould made of the lid of a flat paper or wooden box, and powdered after cooling. It should weigh about 100 g., depending on how much can not be poured from the flask, but not more than this is used in the subsequent distillation.

The distillation is then conducted in the apparatus in Fig. 3, following the directions and precautions already given. The product is recrystallised once from 96 per cent. ethyl alcohol which gives 22-25 g. of yellow needles melting at 192-193° C. (cor.). Further recrystallisation and boneblacking will yield it still paler in colour and melting at 194.8° C. (cor.) as already described.

9. Benzal-Dehydrothiotoluidin.

To a saturated solution of dehydrothiotoluidin in alcohol, add the calculated amount of benzaldehyde from the equation: $C_{14}H_{12}N_2S + C_7H_6O = C_{21}H_{18}N_2S + H_2O$. Heat to boiling for a few minutes and allow to stand to crystallisation. The yield is practically quantitative, and this method may be conveniently used to recover the base from the solutions remaining from its purification, as the condensation product is much less soluble in 96 per cent. ethyl alcohol than the dehydrothiotoluidin itself. Recrystallise the product from alcohol in which it gives a pale yellow strongly fluorescent solution, and from which it appears in very pale yellow, odourless, glistening plates melting at 193° C. (cor.).

Calculated for $C_{21}H_{18}N_2S$	S=9.76%
Found	S=9.80%

10. Dehydrothiotoluidin in the Atophan Reaction.

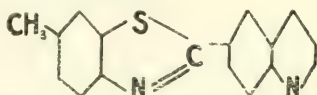
Dehydrothiotoluidin being a primary amine should condense with benzaldehyde and pyruvic acid to give a methyl benzothiazolyl atophan similarly to the reaction

which Dobner and Giesiecke⁷⁸ found that aniline underwent. The reaction was therefore tried following this method, but substituting the molecular quantity of the sulphur base for the aniline. The benzaldehyde condensation product was isolated from the reaction mixture, but no new compound corresponding to atophan was found, although small amounts of an amorphous brown material soluble in toluene, but insoluble in sodium carbonate and hydroxide, were formed.

The experiment was repeated, using the benzal-dehydrothiotoluidin instead of the two substances individually, but after 24 hours' heating practically all of the material was recovered unchanged, although small amounts of an amorphous, highly insoluble brown material were formed. Dehydrothiotoluidin apparently will not condense to form a substituted atophan.

11. 6 (6-Methyl Benzothiazolyl) Quinolin.

Like other primary amines, dehydrothiotoluidin should condense with glycerine in the presence of sulphuric acid and an oxidizing agent such as nitrobenzene,⁷⁹ arsenic acid,⁸⁰ ferric sulphate,⁸¹ etc., to yield a quinolin of the structure :



if the reaction proceeds analogously in this case.

The method of Skraup was first used, it having previously been found⁸² that practically no quinolin results from reaction of the reduced nitrobenzene during the reaction. 56 g. of crude Casella dehydrothiotoluidin and proper molecular quantities of the other substances, were heated according to the directions. The reaction mixture turned red at once, and a reddish, oily tar formed on the surface as the reaction proceeded, a yellow

solid forming on the bottom toward the end of the reaction when the mass became very viscous and boiling slowed up. The mass solidified on cooling, 300 cc. of water were added, and it was distilled with steam to remove the nitrobenzene. The residue in the flask was neutralised with warm sodium hydroxide, filtered and dried, and distilled in vacuo, as it was expected that the new compound would probably be a solid because of its high molecular weight, and complex structure, a conclusion which was later justified. A small amount of yellow solid distilled over with a vile smelling liquid. The solid was filtered off and dissolved in concentrated hydrochloric acid, from which it was precipitated with water. It was recrystallised from hot alcohol, and the red, fluorescent solution deposited small light brown crystals (1 g.), with a tobacco-like odour, melting at 142° C. (uncorr.).

The use of the crude dehydrothiotoluidin was thought, however, to offer too many other possibilities, so the reaction was repeated using pure material, and following the method of Kneuppel, with appropriate modifications for the different physical properties of the new substance, which was expected to give a better yield.

15 g. (0.07 moles.) of pure dehydrothiotoluidin is dissolved in 20 cc. of concentrated sulphuric acid which is slightly more than the amount necessary in the original method, but is required because of the physical properties of the amine, and 21.7 g. of glycerine and 10.6 g. of arsenic acid were added to the solution in a one litre flask equipped with an air condenser. The large flask is necessary because the reaction is vigorous and the mixture foams up and will run all the way up the condenser otherwise. The mixture is heated, is red at first, but vigorous ebullition soon begins and continues even if the flame is removed, and turns brown as the reaction proceeds, the mixture foaming up. The temperature is kept constant at 190° by means of an oil bath. Stop heating after 1½ hours, cool, and add 500 cc. of water. Continued shaking gives a deep brown solution that appears homogeneous.

Neutralise with solid sodium hydroxide. The solution becomes light brown at the neutral point, and deposits a black, tarry material, which is involatile and cannot be distilled with steam.

Filter off and dry the black solid. Distil in vacuo in the apparatus designed for dehydrothiotoluidin. The mass melts, and the product distils over around 250° C. at 45

78. Döbner and Giesiecke, *Ann.*, 242, 291 (1887).

(See also Garzarolli and Thurnlackhi, *Berichte*, 32, 2276 (1889).

Pfützing, *Jour. Pr. Chem.* (2), 38, 583 (1905).

79. Skraup, *Monatshefte*, 1, 316 (1880).

Wiener, *Monatshefte*, 2, 141 (1881).

80. Kneuppel, *Berichte*, 29, 709 (1896).

81. Barnett, *Chem. News*, 121, 205 (1920).

82. During an unpublished synthesis of ortho-tol-quinolin.

mm. pressure. A small amount of water and thiophenols distils over with it, and the product is therefore crystallised from ethyl alcohol in which it gives an orange-red fluorescent solution. Methyl-thiazyl-quinolin appears in microscopic pale brown crystals melting at 147°C . (cor.). The yield is 2.5 g. or 15 per cent. from the equation:

$\text{C}_{11}\text{H}_{12}\text{N}_2\text{S} + \text{C}_3\text{H}_8\text{O}_3 = \text{C}_{17}\text{H}_{12}\text{N}_2\text{S} + 4\text{H}_2\text{O}$.
The product was identical with that obtained in the first experiment, and has a characteristic faint tobacco-like odour.

Qualitative analysis showed the presence of carbon, hydrogen, nitrogen, and sulphur, and the compound was analysed for sulphur.

Calculated for $\text{C}_{17}\text{H}_{12}\text{N}_2\text{S}$ S = 11.59%

Found S = $\begin{pmatrix} 11.69\% \\ 11.61\% \end{pmatrix}$

The new base is a typical quinolin, and adds methyl iodide directly, a mixture of equal moles of this and quinaldin methiodide reacting in the presence of caustic alkali to produce a substance of a deep purple-red colour, analogously to quinolin itself. The product is probably of the cyanine type, and it would be interesting to investigate the further condensation of methylbenzothiazolyl quinolin methiodide with this, lepidin, other substituted quinolins, as well as with 2-methyl-benzothiazole which Hofmann, as has already been mentioned, observed to undergo similar reactions.

DISCUSSION AND CONCLUSIONS.

1. The thiazole structure does not appear to function as a chromophore, or at least, functions very poorly. A large number of benzothiazoles have been described in this paper, and they are representatives ones, of which as has been seen, the large majority, even of those which contain groups which are ordinarily accepted as auxochromes, such as the hydroxy, the hydrosulphide, methoxy, ethoxy, nitro (which is also a chromophore), etc., are colourless, and the remainder in a pure state are only faintly coloured, as dehydrothiitoluidin, and are not dyes. The primulins and chromins are exceptions, but do not furnish a valid objection to this conclusion, as their structure is not yet established. In the dyes of this series, it is therefore concluded, the chromophore must be the azo or other group, though the thiazole structure may, and probably does play an important part in modifying the colours obtained.

2. The thiazole structure is not an odorophore. The odoriferous compounds, as may be seen from Hofmann's work and other investigations described herein, are closely related to the mother substance, benzothiazole, and the farther we get from this by substitution, the fainter the odor becomes. In the odorous compounds, as has been previously observed, the smell is strongly suggestive of pyridine and the other nitrogen bases, and appears to be associated with the tertiary nitrogen atom. This is further borne out by another fact developed in this paper. Dehydrothiitoluidin is odourless, but the benzothiazolyl quinolin synthesized from it has again the typical plant-base odour somewhat resembling nicotine, which it acquires on the introduction of the second tertiary nitrogen atom. The peculiarly aromatic odour of "Rosenkörper" is hence a purely fortuitous circumstance and indeed, the odour of this when in a pure, dry state is very faint, and it requires some stretch of the imagination to be reminded of "tea-roses and geraniums."

3. The commercial methods by which dehydrothiitoluidin is being prepared at present give yields of the base which do not exceed 35 per cent., and some of this must necessarily be lost in subsequent purification. From the work done in this paper, the direct separation of dehydrothiitoluidin and primuline, if formed in the same mixture with other substances, does not seem to be possible (other than by distillation) if by such a method is meant one which will give large yields of the base in a state of purity indicated by good crystalline form, and a melting point of 191° or over. The problem must be solved by the discovery of a method of synthesis which will avoid entirely the simultaneous formation of primulin, if it is to be solved at all.

SUMMARY.

1. A fairly complete resume of previous work in the benzothiazole field has been given, the chief contribution of the investigators noted, and some attractive lines for further research have been indicated.

2. The following new compounds have been prepared:

- 2 Paratolylbenzothiazole.
- Nitroparatolylbenzothiazole.
- Aminoparatolylbenzothiazole.

22 azo dyes from aminoparatolyl benzothiazole.

Tri (2 anilino-benzothiazolyl) carbinol.
 Di (2 benzothiazolyl) fuchsone benzo-
 thiazolylimine.
 Primulin azo benzoylene urea.
 Paranitrobenzal paratoluidin.
 Benzaldehydthiotoluidin.
 6 (6 methyl benzothiazolyl) quinolin.

3. From the consideration of about one hundred compounds of the benzothiazole group, including those prepared in the course of this work, and others described by previous workers, it has been concluded that the thiazole structure is not a chromophore.

4. Of all the compounds given, only seven have characteristic odours, and only one has one which differs from what we should expect from structural considerations of genetic relationship. It is therefore concluded that the thiazole structure is not an odorophore.

5. Apparatus has been developed and a laboratory method has been given for the preparation of dehydrothiotoluidin in a state of purity, which, judged by its melting point (194.8°C ., cor.), has not been attained by previous workers, and a critical study has been made of the reactions and processes by which it is being obtained at present.

[The Author wishes to append a note of thanks to Prof. M. T. Bogert, of Columbia University, under whose direction the work was done, and to Prof. W. L. Prager, of the College of the City of New York, in whose laboratory some of the analyses were performed.]

Miscellaneous References.

For patents dealing with azo dyes from dehydrothiotoluidin and others see:

Friedländer. "*Fort. der Theerfarben-fabrikation*" (all volumes).

Winther. "*Patents in Organic Chemistry*."

For general information regarding sulphur dyes:

Cain and Thorpe. "*Dyestuffs and Intermediates*."

Knecht, Rawson, Lowenthal. "*Manual of Dyeing*."

Fay, "*Coal Tar Dyes*."

Richter Lexicon, Beilstein, Schulz and Julius, etc.

DEFINITION OF RELATIVITY.

(TWO SUPPLEMENTARY NOTES).

By F. H. Loring.

These two notes are a continuation of my article in this Journal of June 30th, 1922, page 381.

1. The relative principle may be indicated by the following statement, bearing in mind of course the obvious fact that the exceedingly rapid movements of the observer are impossible in practice, but they will serve to illustrate the principle (an actual case is given in Note 2 below):—If I look squarely at a picture, it looks normal and its frame appears to be, say, 3 feet by 3 feet. This is a stationary view. If, now, I am rushing with a prodigious speed past the picture, its frame should appear, say, 2 feet wide by 3 feet high. If, again, I am rushing past it with the velocity of light, the right-hand edge of the frame will be seen to merge with the left-hand edge, and if anything at all then can be seen, it would only be a *line*. This is what happens when the Lorentz equation is applied to the problem of relative motion; for, when $v=c$ the equation= 0 . If, as another consideration, the velocity of light only were infinitely great, the quotient (v^2/c^2) would become infinitely small, and there would be no change from unity in the equation; and this is what happens when Newton's theory, or the Galilean transformation, is used; or, in short, when "things" are instantaneously extensive there is no change of time or length due to relative motion: the picture does not appear narrower to the fast-moving observer. Einstein (his book, page 33) says: "The Galilei transformation can be obtained from the Lorentz transformation by substituting an infinitely large value for the velocity of light c in the latter transformation." Adhering to the Lorentz transformation and working with *low* relative velocities it gives answers practically agreeing with Newton; and, when the stationary observation is made, the agreement with Newton (still using the Lorentz equation) is *exact*. Thus it will be seen that the equation meets all cases, and its form has *not* to be altered to suit extremes. The velocity of light (c) becomes a limiting factor in the equations. This equation, as given in the second paragraph (p. 382), merely represents the projected length as

seen by virtue of the relative movement, whether this be *length* (which becomes shortened) or *time* (which becomes lengthened); and this is a problem of simple geometry. Pondering over these matters, we are led to expect the velocity of light to be of a fundamental nature; so fundamental, in fact, that the particular velocity (c) involved could not be strictly limited to one type of phenomenon, such as the propagation of light or electromagnetic waves. A quotation from Eddington's book, "Space, Time and Gravitation" (pages 94 and 60), will suitably close this note. "Finally, is the force of gravitation propagated instantaneously, or with the velocity of light, or some other velocity? Until comparatively recently it was thought that conclusive proof had been given that the speed of gravitation must be far higher than that of light. . . . In the theory given in this book, gravitation is propagated with the speed of light, and there is no discordance with observation." Furthermore, "on the whole, the evidence seems to be against the existence of anything moving with a speed beyond that of light."

2. The following, taken from Eddington's *Romanes Lecture* (1922) on the Theory of Relativity* will help to make the definition of relativity clearer:—"I will conclude this part of the argument with an experimental application which illustrates the power of Einstein's method. Much study has of late been given to electrons moving with very high speeds; for example, the β -particles shot off from radio-active substances are negative electrons which sometimes attain speeds of 100,000 miles a second. It is found by experiment that the rapid motion produces an increase of mass of these particles. I want to show that the theory of relativity gives a very simple explanation of just how this increase of mass occurs. But I must first remark that an explanation had been previously given which had generally been accepted as satisfactory. The phenomenon was actually predicted by J. J. Thomson before relativity was thought of; because, assuming that the mass of a β -particle is of electrical origin, an application of Maxwell's equations shows that it ought to increase with velocity. But the precise law of increase cannot be predicted on this basis, since various plausible assumptions lead to slightly different results. Moreover, Maxwell's equations are, after all, only empirical laws, with a mystery of their own; it was a notable advance to connect the

change of mass at high speeds with other phenomena whose strangeness had disappeared by long familiarity, but there is still scope for a more far-reaching explanation. Einstein takes us straight to the root of the mystery, and he clears up one point which was misleading, if not actually wrong, in the older explanation. The change of mass does not in any way depend on whether the mass is of electrical origin or not; it arises simply from the fact that mass is a *relative* quantity, depending by its definition on the relative quantities, length and time. Let us look at the β -particle from its own point of view; it is just an ordinary electron in no way different from any other. But it is travelling unusually rapidly. 'That,' says the electron, 'is a matter of opinion. So far as I am aware I am at rest if the word *rest* has any meaning. In fact I was just contemplating with amazement *your* extraordinary speed of 100,000 miles a second with which you are shooting past me.' Of course our motion is of no particular concern to the electron, and it will not modify its constitution on our account; so it keeps its mass, radius, electric field, &c., equal to the standard constants applying to electrons in general. These terms are relative, and refer therefore to some particular frame of space and time—clearly the frame appropriate to an electron in self-contemplation, viz., the one with respect to which it is at rest. But this frame is not the usual geocentric frame to which *we* refer quantities, such as length, time and mass; there is a difference of 100,000 miles a second between our station of observation and that of the β -particle in self-contemplation. It is a mere matter of geometry to discover what the β -particle's lengths and times become when referred to the partitions which we have drawn across the world. But when we calculate the consequential change of mass resulting from the changes of length and time, we find that it should be increased in precisely the proportion indicated by the most refined experiments. The point is that every electron, at rest or in motion, is a perfectly constant structure; but we distort it by fitting it into the space-time frame appropriate to our own motion with which the electron has no concern. The greater our motion with respect to the electron, the greater will be the distortion. The distortion is not produced by any physical agency at work in the electron; it is our transformation of the reference frame purely subjective distortion depending on

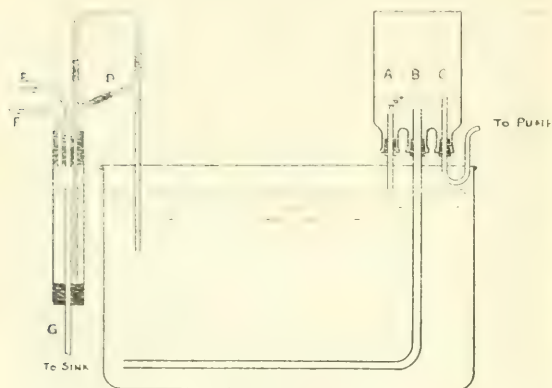
of space and time. This distortion involves a change in our physical description of the electron in terms of mass, shape, size; and in particular the change of mass agrees precisely with that found experimentally."

* Page 19: pamphlet published by the Clarendon Press.

AN APPARATUS FOR STIRRING A BATH USING WATER POWER.

BY C. H. D. CLARK, B.Sc., AND G. T. P. TATHAM, B.Sc.

The following device for stirring the water in a thermostat has been found very useful in a place where electric power was not available:—



The main part of the apparatus (see Figure) is a three-necked bottle, of capacity about 500 cc., supported in an inverted position over the bath, as shown. The three necks are corked and carry tubes, A, B and C. A is a short straight tube, diameter 3 mm., just reaching the surface of water in the bath; B is a wider tube, diameter 1 cm., arranged as shown; C is connected to the filter pump and terminates within the bottle, about 5 cms. above the neck. On exhausting the bottle by means of the pump, water rises until the lower end of A is uncovered, when air enters in a stream of bubbles along with water which passes down the tube B, and so maintains a constant circulation in the bath. Incidentally, the level of water in the bath is prevented from rising above the lower end of A, any excess of water being removed by the pump.

The level of water in the bath is kept up to the lower end of A by the constant level arrangement shown on the left of the diagram. This consists essentially of a siphon tube D, made up of two bent T-pieces connected by rubber joints with each other and with another connected above, as shown. By this means, breakage of the siphon by air bubbles is prevented, as they collect in the top of D, and are removed periodically by blowing down the tube E. Water must be arranged to enter in a slow stream from the tap by the tube F, and to overflow through the wider tube G, the upper end of which is very slightly above the lower end of A. The correct position for G is found by experiment, starting with it below the position, and gradually raising it until the water in the bottle just maintains itself at the level of the top of the tube C when equilibrium is attained. In practice, it is better to have both parts of the apparatus supported on the same stand, so that they always remain in the same relative position; also to turn the bottle through 90° from the position shown to economise space in the tank, the positions in the diagram being for purposes of clearness only.

A fairly small suction at the pump will usually produce effective stirring. This can be found by trial, introducing, if necessary, a little coloured liquid at the lower end of A, and watching the circulation set up. In conjunction with a good thermostat, there was to be found a maximum deviation of temperature in different parts of the tank of $\pm 0.1^\circ \text{C}$. By modifying the levelling arrangement, the device could be used for liquids other than water in the bath. On introducing or removing an object into or from the bath, a change of level occurs which may slightly upset the temperature adjustment, but equilibrium is again attained fairly quickly.

The device described above appears to be better for the purpose than the use of a water turbine in economy of power, and in that it can be quickly set up anywhere from first-hand materials at low cost, and that there is no complicated mechanism to go out of order. The apparatus has been left running during a set of experiments lasting several weeks, and was found to continue to work satisfactorily, the temperature remaining constant. It possesses advantages over the plan of bubbling air through the tank in efficiency of stirring, and in that the liquid is not irregularly or violently agitated, a regular circulation being set up.

THE INSTITUTION OF MINING AND
METALLURGY.—PRESIDENTIAL
ADDRESS.*(Delivered at the recent Annual General
Meeting).*

By S. J. SPEAK, A.R.S.M.

(Continued from Last Week.)

My remarks thus far on the subject of technical education have all been in respect of the work the Institution has done for others, but the Institution also does direct work for its own members. As said by J. H. Collins in his Presidential Address in 1895: "One great reason for the establishment of this Institution is the fact that from the nature of the case the education of the mining engineer and the metallurgist is never completed until his career is ended. . . . We meet and discuss and publish so as to learn from each other and teach one another."

Our publications are read with great interest by most of our members; some, perhaps, consider that they are not always up to the desired standard of excellence. The war has no doubt had some detrimental effect on our publications, both by disturbing the occupations of our members and by increasing the cost of printing, so that we have some reason to hope for a larger number of valuable contributions in the near future. It must, however, always be remembered that the Institution cannot publish epoch-making papers if our members do not send them to us. Unfortunately there is a type of member who never writes, but demands good reading, and often this same type believes that the sole duty of the Institution is to publish technical information. My Address will, I hope, induce such to take a broader view of the work of the Institution.

OVERSEAS MEMBERS.

Our Institution is unique amongst technical institutions in regard to the proportion of its non-resident members. A considerable number of our members are resident in Dominions possessing technical societies of their own. Our last thought is to do anything but to encourage and strengthen such local societies in every way, though at the same time we must maintain the interest of all our members in our own work. With this object a number of Overseas Committees were constituted recently, and some have already done very

useful work, notwithstanding the limited powers it is possible, under its Charter, for the Institution to delegate to them. The situation, in some respect, is rather a delicate one. It is readily understandable that a member residing, say, in Johannesburg—where there exists an excellent technical society—may feel inclined to save payment of our annual subscription. Being occupied for the time being only in the production of gold, he may not feel interested in many of the papers that we publish. He will, however, secure many of the benefits of the work we are doing for the good of the profession in general without subscribing towards our costs.

In this connection I would like to recall the reports of the Institution on "Ore in Sight"; "Mesh of Wire Cloth"; "Mine Accounts and Cost Sheets"; etc., all of which have proved useful to the profession in general. The valuable report on Mine Accounts and Cost Sheets has not yet received the general recognition that it deserves, possibly because the mining engineer is often not the arbiter of the form in which his company's accounts shall be prepared, and also because a logical system of accounts is hampered by the requirements of taxation authorities. Standardisation work of the above nature must, in order to be successful, be initiated by a central and influential body.

Overseas members do miss some of the amusement which they would occasionally get by attending our meetings. The discussions as printed and circulated are, very properly, edited to soften all remarks that might seem offensive to the author of the paper under discussion, and also they are curtailed and shorn of non-essential matter. During my term of office I would like to see free verbal discussion as in the past, but would impress upon those taking part, to revise and condense their remarks, as drastically as possible for publication. It is not always sufficiently understood that the Institution does not undertake to publish every contribution to a discussion that may be submitted, neither is it at liberty to modify materially any such contributions without permission from the writer, which may be difficult to obtain should he reside at a great distance. I ask therefore, that all submitting contributions to discussions for publication should remember to cut out every unnecessary word, and thereby spare the time of readers. As our discussions are always of great value, some-

times more valuable than the paper discussed, we encourage discussion but advise brevity.

The chief object of my Address this evening is to place the work of our Institution before our overseas members in better perspective than they can be expected to have from a great distance. The mining engineer must at some time or other wander over a considerable part of the globe if he is to gain a comprehensive knowledge of his subject. He may feel happy in his present occupation, but in time he will desire a wider experience, and then he will more readily appreciate the benefits of membership of this Institution. We are cosmopolitan in character, and have undertaken work for the general benefit of the profession which no local society could accomplish.

In the Council's Report for the year 1920 one of the objects of the Overseas Committee is stated to be:

"The increase in the roll of membership by securing the inclusion in it of all who possess the necessary qualifications, to whom the advantages of belonging to the central professional body should be obvious, without diminishing but rather increasing their interest in and service to the kindred local societies."

Our Institution has at no time canvassed for new members, for the reason that it would be unfair to press a man to join and then be stringent about his qualifications for admission. We intend to continue our careful scrutiny of candidates, but at the same time strongly desire all qualified engineers to join our organisation, in order that we may safely say of any Britisher who is not a member, that he is not one for the reason that he does not possess the necessary qualifications.

As we are practically in that position to-day, it is most desirable that any member knowing any qualified engineer should impress upon him the importance and desirability of his joining us. We cannot offer him such direct material benefits as a trades union can, if for no other reason than that the conditions of occupation of our members are so diverse that it would be impossible for us to attempt to lay down scales of fees and salaries. However, by supporting the Institution the gulf between the qualified and partially-qualified is enlarged, and this must tend on matters of employment to the benefit of those who bear our stamp of recognition.

THE METALLIFEROUS MINING INDUSTRY.

Though London is the most important centre of this industry, there exists no organisation to represent the industry as a whole.

There are Chambers of Mines representing various districts, but without means of acting collectively. Our Institution directly represents only the professional men engaged in the industry.

On our suggestion a Joint-Committee was formed in 1916, representative of the principal mining companies whose headquarters are in London, for the special purpose of action in respect of new taxation then being imposed. This Committee did effective work with regard to Excess Profits Duty and the incidence of Income Tax as applied to mines. The Committee made representations to the Royal Commission on the Income Tax in 1919 with regard to the recognition of mines as wasting assets. Hitherto the only wasting assets for which an Income Tax allowance was made were plant and machinery and certain buildings that contain plant and machinery.

The Commission recommended (1) that when a British company purchased from a foreign resident the right to work a foreign mine, that an allowance should be made for the amortization of the capital sunk in the purchase; (2) that an allowance should be given in respect of all inherently wasting assets which have been created by capital, such as buildings and foundations, surface works . . . shaft sinkings and initial work of development. The allowances recommended are not, however, equivalent to the full amortization of the capital sunk. Some other lesser injustices from which mining has suffered are also recommended to be alleviated.

I understand that the Government intend to adopt these recommendations, and will introduce them when a newly codified Income Tax Law is prepared. There still remain, however, many matters that can only be dealt with effectively by an organisation that can speak for the whole industry with one voice. Our Institution alone could do little to remove the injustices that existing laws impose upon the mining industry, though we are deeply concerned with the prosperity of the industry.

We may, however, I hope, be useful in inducing the formation of an organisation that can represent the whole industry, which will be able to take action in all mat-

ters affecting the economic interests of the industry. Such an organisation could also render valuable services to the public.

I have often been asked by newspaper men why our Institution took no steps to expose a particular mining promotion then before the public, which to the initiated was obviously a fraud. We certainly have a duty as a Chartered Institution to protect the public interests so far as possible, but I contend that it is beyond our scope to attempt to decide on the merits of financial transactions. An organisation representing the whole metalliferous mining industry might, however, take action, directly or indirectly, to warn the public against fraudulent promotions, for it is to their own interests that the public should receive a square deal.

In London there are one or two papers which undertake exposures of fraudulent promotions, notwithstanding the legal actions to which they thereby render themselves liable. These venturesome papers do not circulate sufficiently extensively or else it must be that there is a fresh crop of fools born every year. An organisation representing the industry would be more effective.

Another matter that could receive the attention of such an organisation is the effect of double Income Tax. The Royal Commission recommended no change in the existing situation as to double taxation of the same income by the United Kingdom Government and by the Government of a foreign State. This is not only bad for the industry, but for the country generally, for by driving away the financing and direction of many mining enterprises from London, this country has lost many orders for plant and materials that would otherwise have been placed here. The report of the Royal Commission states: "this country imposes a tax on all income *arising* within its borders; it also taxes the income of a person resident here, in whatever part of the world his income may have its origin." The most objectionable feature is that in practice it is held that if a company is registered here, its income *arises* here and is taxable.

An organisation representative of the whole industry might also take useful part in considering the relationship between gold and currencies, instead of leaving this matter entirely in the hands of bankers and economists. Though the effects of the increased production of gold due to the great gold discoveries in California, Australia

and the Transvaal are well understood by economists, the probable effects of the present seriously diminishing gold output is apparently being lost sight of.

When the chief currencies of the world are rehabilitated on a free gold basis, the effect of the decreased gold output during recent years will become very noticeable, and will accentuate the difficulties of deflation.

Were it not that the Institution hopes to publish a paper at an early date by one of its members, I would have ventured to explain more fully the reasons why I think that an influential body, such as I am now suggesting, representing the producers of probably more than half of the gold output of the world, could and should let the Government and the public know their views on the situation.

Hitherto the Government has been guided in its monetary policy by financiers and economists; but if, as seems possible, these advisers have not attached sufficient importance to gold production, the actual position should be made clearer to them.

It should be noted that the situation concerning the future production of gold is different from that of other metals. The latter were subject during the war, to a large extent, to the ordinary law of supply and demand, whereas gold was artificially controlled. As compared with 1913, the production of gold has fallen off relatively little more than that of lead and tin, and much less than that of zinc and copper. The depression with the base metals has, however, occurred mostly within the last two years, and during the war they enjoyed extra prosperity; but in the case of gold, it has lasted eight years with gradually accumulative effects. Consequently gold production cannot now so readily respond to an increased demand as could the production of base metals.

GENERAL.

I cannot close my Address without some reference to the difficult times we are now going through. Even in normal times the members of our profession must be considered as badly paid, if regard be given to the frequent changes of employment they have to make, with consequent lost time and expense of removal. I will not include also damages for health due to bad climates and for loss of many of the amenities of civilisation, since most of us are prepared to accept these as part of the game. Few achieve a salary of £1,000 per annum be-

fore the age of 30, and on the average probably do not remain on one mine more than five years. Then comes a change, often to some other country, with an interval without salary and often with travelling expenses to be paid. To the bachelor this is no great matter, but to the married man such changes entail serious expense, so that the latter usually are unable to save much.

Nowadays, with a production of gold, tin and lead about three-fourths of normal, and zinc and copper about half, it is not surprising that there should be an unusual amount of unemployment amongst members of our profession. This occurs, too, after a period of eight years of greatly increased cost of living, during which salaries have been increased by insignificant amounts, and often not at all.

Our Council have had this state of affairs at heart for some time, and have sought how they could best assist our members. In the first place the expenses of the Institution have been kept down as low as possible, but unfortunately it proved impossible to avoid raising the annual subscription. Next we have appealed to mining companies to do their utmost to find employment for ex-Service men, and many have done what was possible in that direction. Mining companies have, however, like the engineers, themselves been passing through bad times, and accordingly are not in a position to be benevolent. Our best hope lies in an increased demand for metals and in the meantime our Institution is endeavouring to secure such appointments as become available, for its own members.

At a stage like the present, a large Benevolent Fund would be of inestimable value. We have recently initiated one out of the balance available from the Memorial Fund, but the amount is negligible in comparison with what is needed. This nucleus, coupled with the hard times we are experiencing, should, however, impress upon our minds that when opportunity offers we should do our best to build up a fund of useful size. It has not yet been considered whether some contributing scheme might not be established, but probably a purely voluntary scheme would best suit our case.

It is no doubt the wrong time to make a strong appeal on behalf of the permanent fund which has been established, but we should welcome at once even small contributions to a Relief Fund that would be immediately available for relief of any

cases of distress brought to our notice, and I may say that we have reason to suspect that many deserving cases exist. Mining engineers, perhaps more than any other class, should do what they can to help one another.

The vocation of the mining engineer, which necessitates frequent and oftentimes protracted visits abroad, does not lend itself to the making of many close friendships outside his own profession, amongst those who would be ready to give assistance in times of distress. His intimate friends consist for the most part of brother engineers; often they are away in some distant part of the world when required, and rarely are they rich, for, contrary to general opinion, few mining engineers acquire wealth. We might all at least remember the Benevolent Fund of our Institution in our wills, even if only as residuary legatee.

My last remarks have a pessimistic flavour which I would like to remove by some words of encouragement. Unfortunately I am unable to see any marked signs of improvement in the mining industry, and though I possess the glass eyes to which Shakespeare refers in "King Lear," I cannot follow the advice there given, and "like a scurvy politician, seem to see the things thou do'st not." Fortunately, mining engineers are by nature hopeful, and we must keep on hoping, in which we may be encouraged if we keep calling to mind that it is almost everybody's experience that "most of their worst troubles never happened."

YTTRIUM.

By JOHN MISSENDEN, B.Sc.

Yttrium, which has been classed in the boron group together with lanthanum and scandium, distinctly belongs to the rare-earth metals both by virtue of its discovery and source. It was due to Ekeberg, who obtained the rare earth called "yttria" by separating the substance previously examined by Gadolin, that its isolation from glucina has become a possibility; although, in later years, investigation into the properties of yttria was responsible for the production of pure yttrium together with lanthanum, erbium, terbium, and didymium. Yttria itself, which may be regarded as the chief source of yttrium as its name suggests,

actually accompanies *terbia*, *erbia*, *thulia*, *dysprosia* and *holmia*, the metals of the last three not being quite so well-known as to warrant any description. The proportions of these latter earths are so small compared with the yttria also found, that many authorities maintain that they are *contained* in yttria, an assertion that can scarcely hold good in the face of later results obtained by research.

The yttrium-containing minerals (which, it is obvious, contain the other metallic earths associated with yttria) are mostly of such a form as to appear like complex salts. The silicate minerals are the most important, the basic orthosilicate of iron, beryllium and yttrium (*gadolinite*) being more frequent than the others. There are also the tantalates, fluorides, niobates, phosphates and uranates, the mixtures being apparent from the following table:—

Silicates.	Niobates.	Tantalates.	Uranates.	Fluorides.
Keilhauite.		Keilhauite.		
Gadolinite.	Gadolinite.			
Cerite.				Cerite.
	Samarskite.	Samarskite.	Samarskite.	
	Euxenite.	Euxenite.	Euxenite.	

The quantities of yttrium (*q.v.*) obtained from two specimens are: Samarskite (mined in Raleigh, N. Carolina), 15.02 per cent., and Gadolinite (mined in Ytterby), 42.89 per cent.

As in many other cases of the more obscure elements, much diversity of opinion is held over the true atomic weight of yttrium. Hoeglund¹ states it to be 89.2. Bunsen's figure is 92, while Cleve fixed it at 88.4. A very careful analysis of the sulphate covering a long series of separate results, however, gives a mean of 88.1, and this determination is probably correct, previous errors being explained by the presence of minute quantities of other rare-earth metals.

The spectrum analysis of yttrium chloride is especially worthy of note. The projection shows two groups of distinct lines in the red sector that are somewhat near the sodium line but of slightly lower wave-length. Superficially, yttrium is an iron-grey powder when freshly obtained, and is apt to assume a darkish appearance when kept for an appreciable time. This phenomenon is not to be explained by the combination of the metal with oxygen, as the oxide is white, and precisely the same effect is observed when the metal is placed *in vacuo*. The

change is probably due to the energetic action of light, the darkening process being considerably retarded by preservation in a box from which all light has been excluded.

Cleve¹ prepared pure yttrium by decomposing the double chloride of sodium and yttrium under the influence of an electric current, but a far more simple method is to fuse the ordinary yttrium chloride (*q.v.*) with an excess of sodium. The compounds, as examined, are as follows:—

Yttrium Oxide, Y_2O_3 , may be obtained by adding the pure metal to boiling water, the oxide being thrown down in the form of a white powder. It may be dissolved completely by the mineral acids, and burns with an intense white light when exposed to a flame.

With sulphur, two compounds, *yttrium sulphide*, Y_2S_3 , and *yttrium sulphate*, $Y_2(SO_4)_3 \cdot 8H_2O$, are formed. The former is

produced by raising yttrium chloride to a high temperature and treating it with a stream of sulphuretted hydrogen. It is a yellow powder,² insoluble in water, but soluble in mineral acids. The latter is crystalline, and may be rendered anhydrous at 120° C. An important characteristic of this salt is the fact that boiling water will yield up 47 per cent. of it, this figure being based upon 100 per cent. in solution at 15° C.

Yttrium carbonate, $Y_2(CO_3)_3 \cdot 3H_2O$, is soluble in water, and is a white powder with a high density. It has not been greatly examined.

There are three phosphates worthy of notice:

Yttrium orthophosphate, $YPO_4 \cdot 2H_2O$; *yttrium metaphosphate*, $Y(PO_3)_3$; and *yttrium pyrophosphate*, $2YHP_2O_7 \cdot 7H_2O$. The first and last are soluble, and the last insoluble, in water. The similarity in composition between the anhydrous carbonate

¹ *Compt. Rend.* 1882, XCV., 1125.

² According to Popp, it is a grey powder, but I am inclined to think that he obtained the pure metal, probably by the presence of too much moisture. The records of his examination of this grey powder are vague, and might easily be results obtained through misunderstanding that the grey is yttrium pure.

and the metaphosphate will be observed.

Yttrium chloride, YCl_3 , is analagous in nearly every respect to the iodide, bromide and fluoride. *Yttrium fluoride* occurs in the mineral *ytrocerite* (Schorlemmer) mined in various parts of North America, and presents itself in a variety of colours, such as blue, violet, and brown. It is generally associated with the fluorides of calcium and cerite.

The reactions of the yttrium salts closely resemble the reactions of the zirconium salts, a description of which may be found in my paper published on June 9th (issue No. 3245) in the *Chemical News*.

CHEMICAL NOTICES FROM FOREIGN SOURCES

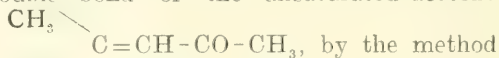
REACTIONS OF CAUSTIC SODA WITH ALUMINIUM SALTS. — *Edouard Grobet*. — The author has studied the effects of concentrated and dilute solutions of caustic soda upon various aluminium salts, using the method of electrical conductivities for the determination of the curves of reaction, and also the new volumetric method with the thermometer as indicator. When caustic soda is added to fairly dilute solutions of aluminium nitrate, the hydrate $\text{Al}(\text{OH})_3$, the aluminate $\text{Al}(\text{OONa})$ and the aluminate $\text{Al}(\text{ONa})_3$ are formed in succession. With aluminium chloride, the sulphate and potash alum, the substances formed are $\text{Al}(\text{OH})_3$, then the basic aluminate $\text{Al}(\text{ONa})_3$, $\text{Al}(\text{OH})_3$, and the aluminate $\text{Al}(\text{ONa})_3$. With concentrated solutions of the nitrate, chloride or sulphate, the basic salt of formula $\text{AlX}_3 \cdot \text{Al}(\text{OH})_3$, or $\text{Al}_2(\text{Y}_2)_3 \cdot 2 \text{Al}(\text{OH})_3$, then the hydrate $\text{Al}(\text{OH})_3$, the aluminate $\text{Al}(\text{OONa})$, and finally the aluminate $\text{Al}(\text{ONa})_3$ are successively formed. When concentrated solutions of potash alum are used, the compounds formed are first the basic salt $\text{Al}_2(\text{SO}_4)_3 \cdot 2 \text{Al}(\text{OH})_3$, then the hydrate $\text{Al}(\text{OH})_3$, the basic aluminate $\text{Al}(\text{ONa})_3$. — (*Journal de Chimie Physique*, XIX., 1921, 329.)

ENESOL. — *G. Rebière*. — The action of sodium methyl arsinat in solution upon oxymercuro-salicylic anhydride leads to the formation of a complex in which the molecules of the two substances are present in equal proportions. This complex contains 33.46 per cent. of "latent" mercury, and the physico-chemical study of the reaction

shows that a compound exists. The injectable solution for which the author suggested the name enesol contains 3 per cent. of this complex, i.e., 11 milligrammes of latent mercury per cubic centimeter. — (*Journal de Pharmacie de Belgique*, IV., 1922, 453.)

ACTION OF THIONYL CHLORIDE UPON THE α ACID ALCOHOLS. — *E. E. Blaise and Mlle. Montagne*. — When lactic and oxyisobutyric acids are treated with thionyl chloride, the chlorosulphite of the acid is not formed, but a compound of a new type, which the authors call an anhydrosulphite of acid alcohols. The two anhydrosulphites which the authors have prepared (lactic and oxyisobutyric) are easily decomposed when heated; at about 120° to 125° under atmospheric pressure they give off sulphurous anhydride, and a polylactide is formed, from which the original acid alcohol can be obtained. The anhydrosulphites are very sensitive to the action of water, and also react with alcohols to give the ether salts of the corresponding acid alcohols with liberation of SO_2 , and the amides of the acid alcohols are obtained from them by the action of the arylamines. With phenyl hydrazine they give thionyl phenyl hydrazine with regeneration of the acid alcohol. — (*Comptes Rendus*, CLXXIV., 1922, 1553.)

CHLORHYDRINE OF MESITYL OXIDE AND ITS TRANSFORMATION INTO THE CHLORHYDRINE OF TETRAMETHYL GLYCERINE. — *M. Pastureau and Henri Bernard*. — The chlorhydrine of mesityl oxide can easily be obtained by fixing hypochlorous acid at the double bond of the unsaturated acetone



by the method of Baeyer, Lauch and Bamberger (action of boric acid upon calcium hypochlorite in solution). The product obtained after fractional distillation is a colourless oily liquid, something like camphor, which turns violet in the light. When a solution of it in anhydrous ether is added to methyl magnesium iodide an energetic reaction takes place which can be moderated by cooling if necessary. Thus a limpid liquid is obtained which can be decomposed by iced water in the usual way. When the ethereal liquid is fractionated in vacuo the portion which distils at 110° under 200 mm. consists of a viscous liquid which turns brown in the light, and from which crystals of the chlorhydrine of tetramethyl glycerine are deposited. — (*Comptes Rendus*, CLXXIV., 1922, 1555.)

NOTICES OF BOOKS.

Organic Compounds of Mercury, by FRANK C. WHITMORE, PH.D. Pp. 397. New York: Chemical Catalog Co., Inc., 1921. Price \$4.50.

The American Chemical Society has arranged to publish a series of scientific and technological monographs on chemical subjects, and as one, Prof. Whitmore has written an able account of the extensive work done upon the organic mercury compounds, which, he states, is probably greater than that done upon the arsenicals, although it has hitherto received less publicity.

The author only briefly mentions the organic compounds containing the groups $-O-Hg$ and $-S-Hg$, and has largely confined his attention to true organic mercurials in which the metal is directly attached to carbon. Nevertheless, a great variety of bodies are described with discrimination. Matter of minor importance receives mention in the bibliography, and although experimental details are omitted, enough is included to indicate the methods and to serve as a guide for preparations or for repetition of any particular work on the subject. The apparent ease and variety of methods for preparing these substances is very impressive and should stimulate further researches.

Some Organic mercury compounds have been used for the preparation of organic derivatives of phosphorus and arsenic. Others have found a limited application in medicine.

The word "mercuration" has been coined to indicate the introduction of the metal into an organic substance (*cf.* bromination, etc.).

There are several appendices, one of which is devoted to the analysis of these bodies and incorporates the author's valuable experiences in this direction. The method of his choice for the estimation of mercury, *viz.*, amalgamation of the volatilised metal with an inverted gold crucible, can scarcely be adopted universally.

This well thought out book constitutes a valuable addition to the scanty literature of organo-metallic chemistry. J. G. F. D.

Industrial Hydrogen, by HUGH S. TAYLOR, D.Sc. Pp. 210. New York: Chemical Catalog Co., Inc., 1921. Price \$3.50.

This technological monograph, also issued by the American Chemical Society,

outlines the fundamental principles of the industrial production of hydrogen.

In the preface it is pointed out that modern chemical industry demands the intelligent co-operation of the chemist and engineer.

Attempts at elimination of the one or the other in the development of a new process, such as the large scale production of hydrogen, would be disastrous. But in treating this subject, neither chemist nor engineer can advantageously intrude upon the domain of the other. Prof. Taylor has therefore emphasised with care and lucidity the essential chemical details of hydrogen manufacture.

All the practical methods for its preparation are adequately described. They include the various ways for decomposing steam with iron; water by electrolysis, and by employing alkali metals, alloys and hydrides; aqueous alkalis with ferro-silicon, and aluminium. Methods for the production of hydrogen from water-gas by liquefaction, etc., and from hydrocarbons by thermal decomposition, and others of less importance are also described.

The chemical aspects of these processes are clearly and fully stated. This is particularly noticeable in the case of the methods using steam and iron. The special utility of some processes which are restricted to local or transport convenience or emergency needs is indicated by such a case as the hydrolith process, whereby it is possible to make 1,000 cu. ft. of the gas from about 65 lbs. of calcium hydride (with water).

Hydrogen for filling dirigibles and balloons is now extensively made by the interaction of ferro-silicon and aqueous alkalis, and this process may be developed considerably in the future.

The monograph deals with the manufacture of hydrogen in a general and comprehensive way, and will therefore be widely read and consulted by industrialists.

BOOKS RECEIVED.

Roger Bacon. *The Father of Experimental Science and Medieval Occultism*. H. STANLEY REDGROVE. First Edition, 1920. Messrs. William Rider & Son, Ltd., 8, Paternoster Row, E.C.4. Price 1s. 6d. net. Pp. 63.

An Inorganic Chemistry. H. G. DENHAM, M.A., D.Sc., Ph.D. 1p. VIII. + 683. First Edition, 1922. Messrs. Edward Arnold & Co., 41 & 43, Maddox Street, W. 12s. 6d. net.

Joseph Glanvill and Physical Research in the Seventeenth Century. H. STANLEY REDGROVE B.Sc. (Lond.), F.C.S., and L. M. L. REDGROVE. 1921. Messrs. William Rider & Son, Ltd., 8 11, Paternoster Row, E.C.4. 2s. net. Pp. 94.

NITROGEN FIXATION.

German and American synthetic ammonia plants. (Design and operation of apparatus used for synthesis of ammonia; description of different processes for removing the ammonia; comparison of costs of construction and production in America and Germany.) R. S. Tour.—*Chemical and Metallurgical Engineering*, New York, Vol. 26, March 1, 1922, pp. 411-15; March 8, 1922, pp. 463-5. 25c.

Contributions to the study of ammonia catalysts: a series of articles from the Fixed Nitrogen Research Laboratory. (Description of apparatus for the small-scale testing of ammonia catalysts at atmospheric pressure.) A. T. Larson, W. L. Newton, and W. Hawkins.—*Chemical and Metallurgical Engineering*, New York, Vol. 26, March, 15, 1922, pp. 493-7. 25c.—(From *Bulletin No. 212 of the Institute of Mining and Metallurgy*).



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 17272—Bloxam, A. G.—Manufacture of azo-dye-stuffs. June 22.
16927—Cassella & Co., Ltd.—Production of dye-stuffs containing sulphur. June 19.
17381—Chemische Fabrik Weissenstein Ges.—Manufacture of hydrogen peroxide. June 23.

- 17159—Ellsworth, J. T.—Process of recovering zinc from complex ores. June 21.
17158—Munn, J. B.—Apparatus for chemically treating mineral oil products. June 19.
17261—Marks, E. C. R.—Zirconium alloys, and processes of making same. June 22.

Specifications Published This Week.

- 158882—Rosthorn, O. von. Process for the manufacture of copper-alloys.
181058—Deutsche Gold und Silber-Scheide-Anstalt vorm. Roessler, and Liebsch, Dr. O.—Manufacture of prussic acid.
181062—Cumberland Coal and Chemicals, Ltd., West, J. H., and Jaques, A.—Methods and apparatus for the production of hydrogen.
181198—Courtaulds, Ltd., and Lloyd, L. A.—Manufacture and production of compounds or mixtures of starch and sulphuric acid.
181247—Napp, H. R.—Process for the manufacture of co-isopropylallylbarbituric acid.

Abstract Published This Week.

Dyeing cellulose acetate.—Patent No. 179384.—A process of dyeing Acid, basic, mordant, substantive, vat, and sulphuretted dyes, has been devised by Burgess, Ledward & Co., Ltd., Wardly Mills, Walkden, and Harrison, W., Beechwood, Walkden Road, Worsley, both in Lancashire. The material is dyed with colloidal dye solutions prepared by adding to a solution of dye or leuco-compound a protective colloid (gelatine, casein, saponin, starch, &c.) and a precipitant (except metallic chlorides); preferably the precipitants are bodies which are themselves absorbed by the cellulose acetate. Suitable precipitates are:—For basic dyes, a weak alkali such as ammonia, a salt of an acid metallic oxide such as molybdates, tungstates, or stannates, or an organic compound of acid character such as tannic acid or salts of phenols, naphthols, aromatic acids, hydroxycacids, sulphonic acids, &c.; for acid or direct cotton dyes, a salt of an organic base such as aniline, benzidine, dianisidine, phenylenediamines, naphthylamines, &c. Sulphur dyes are dissolved in sodium sulphide, hydro-sulphite, &c., and vat dyes in sodium hydro-sulphite, the same precipitants being used as in the case of direct dyes. Examples are given of dyeing triacetate silk in baths containing: Methylene blue, glue, and sodium stannate; magenta, saponin, and tannic acid; tisonal navy blue R, sodium sulphide, glue, dianisidine, and acetic acid; ciba blue 2B or indigo, caustic soda, sodium hydrosulphite, glue, dianisidine, and acetic acid. Mixed goods containing cotton may be dyed with sulphur or vat dyes as described above, the cotton threads being subsequently dyed with direct dyes. The Provisional Specification describes also the use of salts of aluminium, barium, magnesium, &c., as precipitants for direct or acid dyes, and of oxidizing agents such as air, or metal salts as precipitants for vat or sulphur dyes; it also refers to the use of alizarin dyes using metallic salts or mordants or organic bodies as precipitants.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3250

CHEMICALS REVIVE.

FREE TRAINING FOR OUR SILENT DEFENCE CORPS.

An all-round revival of the chemical trade is expected in the immediate future by Mr. Max Muspratt, of the United Alkali Company, Liverpool, who has just succeeded Sir John Brunner as chairman of the Association of British Chemical Manufacturers.

He points out in an interview that the heavy chemical industry "undoubtedly turned the corner at the beginning of the year, and the alkali portion of it, at any rate, has enjoyed real prosperity, shipping to all parts of the world. The acid side of the industry is slowly recovering from the most difficult period in its existence.

"At every turn the signs are promising. With much better reports from the textile industry, I expect that the dye industry will shortly get a real chance to show what it can do, and I am not afraid of its power of making good.

"There is no branch of the chemical industry in which more excellent work has been done than Fine Chemicals, and one of the greatest triumphs of the Association of British Chemical Manufacturers has been the manner in which the fine chemical makers have co-operated both with one another and with other branches of the chemical industry. They deserve every kind of support from the public at large because they are conducting at their works schools of practical chemistry which are of vital importance to the nation both in peace and war."

Sir Alfred Mond; Mr. Shortt, the Home Secretary; and Mr. Stanley Baldwin, President of the Board of Trade, were all guests at the annual dinner of the Association, which was held in private at the Holborn Restaurant, London.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

Journal and Proceedings, June, 1922.

LIVERPOOL AND NORTH-WESTERN COUNTIES.

At the 35th meeting of the Section, held at the Bear's Paw Restaurant on 6th April,

a paper was read by the Hon. W. Hulse Lever on "The Value in Business of Scientific Training," Mr. H. J. Evans in the chair.

Mr. Lever said that some measure of scientific training was useful to the business man—not so much on account of the actual facts learned, as that it taught him to think scientifically.

Modern business was necessarily a large field employing a great many varieties of people. In modern commerce the chemist was employed as a chemist, the engineer as an engineer, the mineralogist as a mineralogist, and so on, but very often the ideal and most successful business combinations had been between a purely commercial man and a purely scientific man.

On the ideal board of directors there should be one scientific or technical brain, one legal brain, and one accountancy brain, with the addition of purely commercial brains.

Where did this vague, indescribable "something" called the commercial man come from? He had passed no special examinations to qualify him for his post. Frequently his sole graduation had been in the school of hard knocks, in the university of everyday life. Although it was becoming increasingly common to receive a University training, there would always be many in business who had not received this training; but, provided some form of training could be given, the question arose as to what form was the best. Undoubtedly any study followed systematically was good for the brain, but there was no training better than a scientific one. In his own case he had decided to take the Natural Science Tripos at Cambridge, and had never regretted his choice. No doubt he thought that to learn something of chemistry would be of direct use in the soap-making industry. It was not, however, for this reason that he found the training to be of use. Enough chemistry to enable a man to understand the principles of soap-making, in so far as they were required to be known by the commercial side of the business, could be learnt in a very short time. The training was of value because it induced a scientific mode of thinking.

The aim of study should not be the storing of facts *ad nauseam*, but the understanding of principles according to which these facts might be applied. In studying chemistry the aim was not to learn off by heart the list of atomic weights or to mem-

orise a host of formulae and equations, which might readily be looked up in a text-book, but to understand what an equation was and to apply the principles underlying it.

After all, the general idea of the chemical equation was cropping up the world over. The balance sheet of a business was, in a sense, an equation, and the understanding of a chemical equation helped one to appreciate a business equation. Under the principle of the indestructibility of matter, capital put into a business must be accounted for in the same way as the chemical reagents put into a test tube, even to the formation of H_2O and the giving off of CO_2 . There was a lot of H_2O and CO_2 about some balance sheets!

The principles learned in science were invaluable to the business man for the four following reasons, among others:—

1. Science seeks simplification.
2. Science seeks standardisation.
3. Science seeks truth.
4. Science teaches humility.

As to the first, scientific investigation explained more and more the phenomena of nature in terms of variations of simple units. The most complex living organism known was only a multiplication of cells, each with its essential protoplasm and nucleus, although the problem of what life really was remained unsolved. The modern physicist had shattered the older chemists' belief in the atom as the indivisible unit of matter by saying that all atoms were only different arrangements of electrons or negative charges of electricity. So must the successful business man ever search after simplicity. He must get down to simple units and arrange his problem in an orderly way. The clever business man could put his finger on the heart of a problem right away, because he knew that all the complications of business were only different arrangements of certain simple and essential principles, which, obeyed, led to success, or, ignored, led to failure.

With regard to the second reason, that science seeks standardisation—the essence of science was measurement, necessitating standards. No business man with a scientific training could rest content with the archaic and unwieldy units with which commerce dealt. The scientific mind craved for a universal metric system, both of weights and coinage, and it was interesting to note how many business houses turned shillings and pence into decimals of

a pound for the internal working of their own system of accounts. The scientific mind also desired a linking up between the measurement of weight and the measurement of volume. Our unit of weight ought to be that of a definite volume of water.

Respecting the third point, that science sought truth—the scientific man in his investigations rarely craved for anything else; and the same should be said of the sound business man. Each should be equally capable of discarding all points and opinions which did not lead towards this goal. The whole history of science was a pilgrimage in search of truth.

At the fourth point, that science taught humility, some might be inclined to smile; but regarded dispassionately and seriously, it would be found to be true. The non-scientific mind was staggered at the accomplishments of science. The scientific man overlooked the accomplishments in face of the mysteries yet unsolved. The unknown was not a definite something which would one day be entirely discovered and turned into the known. It had been truly said that knowledge was like a circle ever widening as it grew, and the more it grew, the greater—not the less—became its area in contact with the unknown.

The business man should take a leaf from the book of the scientific man and realise that the present triumphs of commerce did not represent the last word. The business man who sat down content with himself and his business only sat down to watch the business go back and not forward. The scientific world never rested content; the more it probed into the unseen mysteries the more it realised how little was known and how much there was to know.

We scatter the mists that enclose us,

Till the seas are ours and the lands,

Till the quivering æther knows us,

And carries our quick commands.

From the blaze of the sun's bright glory

We sift each ray of light,

We steal from the stars their story

Across the dark spaces of night.

But beyond the bright searchlights of science,

Out of sight of the windows of sense,
Old riddles still bid us defiance

Old questions of Why and of Whence.
There fail all sure means of trial,

There end all the pathways we've trod,
Where man, by belief or denial

Is weaving the purpose of God.

In the discussion, Dr. Brislee said that he much appreciated the idea of having men with scientific training on every board of directors in order to establish a bond of sympathy between the technologists and the financiers. While it was awkward for the technical man to be bothered with questions of cost, he, nevertheless, should have a definite idea of the value of labour and materials, and work hand in hand with his financial confrères. Separate branches of a concern working in watertight compartments hindered progress. He remembered, for instance, the case of a new managing director of a large locomotive works, who, at the outset, stated he had not come to make locomotives, but to make money. An unsympathetic attitude made things very difficult for the researcher, who might easily be presented with difficult problems on which he might spend a large amount of diligent and intelligent work with little practical result. A still more disappointing result followed when he was directed on a wrong course and asked to get out certain desired information, perhaps involving a deal of labour, when he knew from the outset that it would not lead to the end desired. The researcher thus appeared to be doing a large amount of unproductive work, and, indeed, was often required to carry out an investigation which was not immediately realisable as a financial asset. It was becoming increasingly incumbent upon industrial chemists to undertake pure research, because they could not predict when a discovery would become of technical importance, especially when the theoretical groundwork had not been cleared. The non-technical mind could not always appreciate the fact that lines of research, projected on the idea of definite direction of investigation leading to a definite result, were not always practicable. The experience of Research Boards all over the country amply proved this. He much appreciated Mr. Lever's view that some knowledge of science on a board of directors would establish a link of sympathy, and he was confident that it would spur the chemist on to better work.

Mr. Stocks said they were very much indebted to Mr. Hulme Lever for his interesting and instructive address, and hoped that they would have the privilege of hearing him on future occasions. With regard to the relationship of science to industry, there were many ancient industries, such as dyeing and leather manufacture, which, although depending on scientific

principles, had grown up without scientific control, simply by those in charge trying various experiments, rejecting the failures, and assimilating the useful ones. This method was a tedious one. Although matters were now much altered, chemists were not yet appreciated at their true value. There were many works which did not yet employ chemists, and often the chemist was not called in until something awkward happened which he had to put right. A chemist, if he was any good at all, would learn his business, and would be able to teach workpeople how to do things properly in order to avoid mistakes which it was necessary to rectify. He hoped to live to see the time when a chemist's starting salary would be £1,000 a year. In a large works, where specialisation was necessary, chemists were grouped into analytical chemists, research chemists, and works or process chemists; but in a small works the chemist had to be all these, and perhaps in his spare time help in other ways, even with book-keeping and despatching goods. In some works the chemist was kept too much in the laboratory and not allowed to go into the works, where he was regarded as a bit of a nuisance, as he was always nosing into things; but he advised them to get out into the works as much as possible and learn as much as possible. He was interested in Mr. Lever's ideal board of directors, especially that it should contain at least one scientific man, and he hoped that even more than one would be appointed to each board. Although often regarded as having little business ability, scientific men were in many cases more businesslike than business men, and there was no reason why scientific attainments and business ability should not go together. One attribute of the scientific man, that of humility, mentioned by Mr. Lever, was illustrated by a quotation from Bishop Spratt referred to in the "History of the Institute of Chemistry," which he read.

"The chymists lay it down, as a necessary Qualification of their happy Man, to whom God will reveal their ador'd Elixir, that he must be rather innocent, and virtuous, than knowing. And if I were to form the Character of a true Philosopher, I would sure to make that the Foundation: Not that I believe, God will bestow any extraordinary Light in Nature, on such Men more than others; but upon a bare rational Account: For certainly, such Men, whose Minds are so soft, so yielding, so complying, so large, are in a far better Way, than

the bold and haughty Asserters: they will pass by nothing, by which they may learn; they will be always ready to receive, and communicate observations; they will not condemn the Fruits of others Diligence; they will rejoice to see Mankind benefited, whether it be by themselves or others."

Among the wonderful things which the chemist in the works could now do, according to a report in the *Echo* recently, was the manufacture of nitroglycerine from vegetables. At first sight this would appear similar to making T.N.T. from turnips, but the journalist had seized upon the least interesting part of his communication for his title, the real object being the extraction of palm oil.

Mr. Knowles thanked Mr. Lever for his very interesting lecture, and wished to place before the meeting his own views of how the chemist fared in Germany previous to the war. There was no doubt that Germany built up her great chemical industry, and particularly her coal tar colour industry, by getting the best chemical brains possible into the business. There were always chemists on their boards of directors, and frequently a chemist in charge of process work, besides the chemists required for control of materials bought and the products sold, to say nothing of chemists on research. One thing, however, which impressed him whilst in Germany was that a man was given a post because he was a suitable man from the point of view of his capability, and not because he just happened to be the son of a man who already had a good post in the firm; and there was no doubt that this thorough way of putting business first helped a great deal towards their ultimate success. Another way in which Germany pushed her coal tar colour industry was by the employment of chemists as technical travellers. Inventors were better looked after in Germany, particularly from the financial aspect, as they had a system of banking, e.g., a "Gewerbe Bank," whose business was to lend money on new inventions after they had been thoroughly examined by expert technical men.

Dr. Clarke suggested that the Institute should arrange for Mr. Lever to repeat his address before commercial leaders of industry, because he was able to explain the value of a scientific training in a manner that the specialised man of science certainly could not. In many industries there

was still a lack of sympathy between the commercial man and the chemist. Thus, in the speaker's opinion, was due to two causes: (a) The belief of the commercial man that the chemist was the cure for all ills, and that any difficulty could be turned over to a research department and become solved; the commercial man showed disappointment when a solution was not forthcoming; but he should realise that research by qualified men was only the *best* means of tackling a difficulty and not a sure means; (b) the technical man took the attitude that the commercial man would not understand a technical problem, even if it was explained to him, and hence it was waste of time to attempt it. The commercial man was thus left in mid-air on many technical matters, a thing he naturally resented. The technical man consequently should take considerable pains to keep the commercial man in touch with technical matters, simplifying his explanations as much as possible. In the opinion of the speaker, the chemist was too much inclined to sit down and wonder why his services were not appreciated more, instead of considering whether he himself was not mainly contributing to his non-recognition. The chemist generally was not very adaptable. He frequently showed little tact in dealing with commercial men, as mentioned before, and frequently no tact at all in dealing with plant managers. Plant managers generally had accumulated a wide store of knowledge by exercising powers of observation without any underlying scientific training. They were people who demanded considerable respect from chemists, and not the contempt that they frequently got. If the chemist considered such points as these he would contribute to the better recognition of science in industry.

Mr. Moore said that in most large businesses there were many grades of workers who had different duties. A scientific training would be of benefit to all, but it was of particular value to those who occupied the higher positions. The men who occupied these high positions, besides requiring a thorough knowledge of the business, had to be clear thinkers. It was necessary for them to be of sound judgment, to be able to estimate the value of evidence, and to be able rapidly to select the best line of action out of several possible ones. They should be able to sift the essential elements out of a mass of detail.

They should be men of broad outlook, able and willing, when necessary, to develop the business on new lines and to adapt themselves to new methods and new conditions.

In the course of a scientific training, a student was constantly considering facts and their inter-relations. In his experimental work he was frequently using the facts he knew, in order to produce results which to him were new. If his use of the facts was not proper, or if his thinking lacked clearness, or if his judgment was not sound, then the experiments would be partly or wholly unsuccessful. Thus the clearness of his thinking and the soundness of his judgment were being continually exercised and tested in a practical manner. Many experimental results could be obtained in a variety of ways, and hence the student had to make a choice of one of several methods. He had to consider such factors as time, cost, the apparatus and facilities at his disposal, the purity and quantity of the product, etc. As he advanced in his work, he learned of some of the more important researches that were being conducted, and began to appreciate that knowledge was continually advancing and expanding. His outlook became modified, and he realised that it would be necessary for him, as knowledge progressed, to discard some of the facts and processes which he formerly accepted and used, and in their place to substitute new facts and new methods. In the last year or two of his college training, he would probably have opportunities for taking part personally in some research work, and thus would have the very valuable opportunity of making some personal contribution to the growth of knowledge.

Thus a man who received a scientific training was continually exercising and developing those qualities of mind which were of such importance in business. Not only was he exercising and developing them, but he was constantly using them to produce definite practical results. Hence a scientific training as a preparation for business was very valuable.

Mr. Gabriel Jones, while disclaiming any first-hand knowledge of chemical industry, thought a very important point mentioned by Mr. Hulme Lever was his ideal board of directors, and he believed that probably many industrial concerns had come to grief through the lack of technical brains on the board; it was often unsatisfactory for a

number of purely business men engaged in chemical industry to decide upon a course of action and then to leave their chemists to work out the problem. Chemists engaged in industry had opportunities of meeting their employers on equal terms in such bodies as the Society of Chemical Industry, and he recommended membership of that Society to chemists for that reason, and also for the chance it gave them of helping their purely business associates with their scientific knowledge. Mr. Hulme Lever had likened a balance sheet to a chemical equation, but he (the speaker) thought that there was a difference between the two that was very obvious. Whilst in a chemical equation, one expected the same quantity of matter to result from the reaction as was originally put in, he supposed that a balance sheet in which the "matter" produced was not greater than that supplied would be regarded as unsatisfactory. He thought also, from opinions he had heard expressed, that more co-operation between chemical and engineering staffs in manufacturing concerns was desirable; they were too prone to work in watertight compartments.

Mr. Inman suggested that a report of the meeting should be sent to various chemical journals, with a view to advertising the existence of the Institute, and the proceedings of the Local Section, because the lecturer had stated the scientifically trained man's case so aptly.

The meeting closed with a cordial vote of thanks to Mr. Hulme Lever for his paper.

GEOLOGICAL SOCIETY OF LONDON

June 28th, 1922.

Prof. A. C. Seward, F.R.S., President, and afterwards Mr. R. D. Oldham, F.R.S., Vice-President, in the chair.

The following communications were read:—

1. *The Petrology of the Metamorphosed Rocks of the Start Area (South Devon)*, by CECIL EDGAR TILLEY, B.Sc., A.I.C., F.G.S.

2. *The Glaciation of the Counties of Antrim, Down, and parts of Armagh, Londonderry, Tyrone, Monaghan, and Louth in Ireland*, by MAJOR ARTHUR RICHARD DWERRYHOUSE, T.D., D.Sc., M.R.I.A., F.G.S.

The next meeting of the Society will be held on Wednesday, November 8th, 1922.

ROYAL SCHOOL OF MINES—FRECHEVILLE
RESEARCH FELLOWSHIPS.

The Imperial College of Science and Technology, with which the Royal School of Mines is incorporated, is offering two Research Scholarships of £300 a year each, tenable for one year and possibly renewable for a second year, to aid in carrying out any investigation or research connected with Mining, Mining Geology, Metallurgy, or the Technology of Oil, which, in the opinion of the Selection Committee, is of sufficient use or promise. Applicants, who may be Associates of the Royal School of Mines, or others, and preferably men with some practical experience, should apply in writing to the Secretary of the College (from whom further particulars may be obtained) before September 1st, 1922, giving the nature of the proposed investigation, qualifications for the work, and references. It is anticipated that the Committee will make the awards by the end of November, so that the Fellowships and work may begin on January 1st, 1923. Holders will be expected to devote their whole time to the work, which may be conducted at the Imperial College, or in special circumstances elsewhere, at the discretion of the Committee.

THE DECOMPOSITION OF IODOFORM
IN SOLUTIONS BY MEANS OF
RADIANT ENERGY.

BY E. H. BUTLER.

Many phenomena are manifestations of wave motion. The wave motion differs in the several cases, so that under certain conditions we have sound waves, under others light waves, and again we might get those conditions which give rise to those waves which are more familiarly known as the X-rays.

In any case, wave motion is possessed of energy. Sound waves may cause the shattering of glass at a distance of many miles from the seat of the disturbance, while the whole science of photography owes its name and its existence to the effects produced in specially prepared films by the wave motion which constitutes light.

If wave motion is brought from a high to a low frequency, energy is set free. This

energy may appear as heat or as chemical energy, or both. It is quite possible that it appears in other ways, but the outstanding fact is that transformation does take place. In a system reacting chemically, this transformation may assist that reaction or retard the reaction, though such cases of retardation are uncommon. In the case of light energy, the rate of a reaction is usually increased, the light acting, in a sense, as a catalyst. Such actions are called photocatalytic reactions.

The combination of chlorine and hydrogen has long been known to be sensitive to the action of sunlight. It is a reaction that has been studied very considerably by such workers as Bunsen and Roscoe, and more recently by Badenstein and J. J. Thomson. It is very probable that the chlorine molecules are set in a state of more rapid vibration by a resonance effect, and so made more capable of chemical action.

Decomposition of substances is more common than synthesis in actions using light as radiant energy. The amount of action depends on the amount of light absorbed and also on the amount of that light which has been transformed into chemical energy. Thus, in solutions, the solvent exerts a considerable influence.

The decomposition of iodoform in various solvents was studied. This decomposition has been studied by Plotnikow (*Zeitsch. Phys. Chem.*, 1910, LXXV., 337), who found that the decomposition was monomolecular. This is somewhat surprising, since energy is constantly being supplied to the system, and also because the light intensity must vary at the successive layers of the solution. The reason for this behaviour is not known.

The iodoform solutions were in each case, N/20, and the source of light energy, a 100 candle-power lamp of the half-watt type, placed at such a distance that heating effects were minimised. The solutions were placed in shallow, open dishes. The solvents used being (a) Alcohol (ethyl), (b) Benzene, and (c) Carbon tetra-chloride. The iodine liberated was estimated using sodium thiosulphate solution, N/100.

(a) *Alcohol as solvent*

No iodine liberated after 40 minutes' exposure.

(b) *Benzene as solvent.*

Temperature, 15° C. Value of 'a' = 23 ccms.

Time (mins.).	Thiosulphate used per 5 ccms.	Values of $K = \frac{2.30 \log a}{t(a-x)}$
5	0.40 ccms.	0.00355
10	1.25 "	0.00557
15	1.80 "	0.00543
20	2.30 "	0.00527
25	2.65 "	0.00428
30	3.05 "	0.00536
35	3.25 "	0.00431
42	4.10 "	0.00467
47	4.60 "	0.00474
57	6.05 "	0.00534

(c) Carbon tetra-chloride as the solvent.

Temperature, 15° C. Value of 'a' = 23 ccms.

Time in mins.	Thiosulphate used per 5 ccms.	Values of $K = \frac{2.30 \log a}{t(a-x)}$
5 mins.	0.50 ccms.	0.00437
10 "	0.80 "	0.00354
15 "	2.20 "	0.00570
20 "	3.55 "	0.00835
25 "	4.40 "	0.00834
30 "	5.10 "	0.00832
35 "	5.70 "	0.00812
40 "	7.10 "	0.00917
47 "	7.70 "	0.00856
52 "	8.30 "	0.00852

Decomposition in the case of (b) and (c) did not cease on the withdrawal of the light. The decomposition continued in the case of the carbon tetra-chloride solution for several hours in the dark after exposure to the light, while in the case of benzene as the solvent, decomposition stopped sooner.

Transference of some of the exposed solutions to freshly made and unexposed solutions did not promote decomposition in those solutions. This, however, happens if the source of light energy is more powerful than that employed as above.

The decomposition of iodoform in the above solvents is accelerated by passing a stream of oxygen or air through the solutions. The process is one of oxidation in which formic acid is probably produced though in the above experiments this was not detected owing to the small amount present and also to its volatile nature.

If chloroform is used as the solvent, decomposition is more rapid, but it must be noted that chloroform is itself decomposed in the presence of light, while carbon tetrachloride is not affected.

NOTES FROM FOREIGN SOURCES.

RECENT ATTEMPTS TO SEPARATE

ISOTOPES.*

By A. PINKUS.

Ever since the first researches in radio chemistry were performed, and long before K. Fajans and F. Soddy had clearly stated the problem of isotopy, this disconcerting characteristic of certain radioactive elements had revealed itself—the absolute identity of the most diverse chemical and physical properties in spite of different atomic weights and a definite power of disintegration. The phenomenon was at first regarded as exceptional and limited to the radioactive elements, but was soon perceived to have a much more extended significance. Thus, in 1913, J. J. Thomson's researches on the spectrum of neon and the discovery in the following year of the varieties of lead of different combining weights proved the complex nature of these two inactive elements. Thomson's method of analysis, perfected in 1919 by F. W. Aston, so as to give the masses of the carriers of charges correct to one-thousandth, has enabled this result to be confirmed as regards neon and to be extended to nine other ordinary elements—chlorine, argon, mercury, krypton, xenon, boron, silicon, bromine and nickel. Thus isotopism appears to be a normal phenomenon, exhibited by many ordinary chemical elements. This result acquires a special importance in view of the fact that all the mass spectra, with the exception of that of hydrogen, give whole number atomic weights both for the simple elements and for the constituents of elements recognised as complex. The following table gives Aston's latest results for complex elements:—

* Abridged from the *Journal de Chimie Physique*, XIX., 4, 336.

Element.	Atomic Weight.	Number of Isotopes.	Atomic Weights from mass spectra.
Boron	10.90	2	11;10
Neon	20.2	2	20;22;(21)
Silicon	28.3	2	28;29;(30)
Chlorine ...	35.46	2	37;37 (29)
Argon	39.9	2	40;36
Nickel	58.68	2	58;60
Bromine ...	79.92	2	79;81
Krypton ...	82.92	6	84;86;82; 80;78
Xenon	130.2	5 (7)	129;132;131; 134;136; (128;130)
Mercury ...	200.6	(6)	(197-200); 202;204.

(The numbers in brackets are not regarded by Aston as definitely established).

As the domain of isotopism enlarges, the question of the separation of isotopes acquires increasing importance, especially for inactive elements such as chlorine and mercury for example, the complex character of which has been revealed only by the positive ray method, and which seem to exist in nature only in mixtures which are always identical. The electromagnetic method, moreover, only leads to indeterminate quantities of simple separated atoms, and hence cannot be used in the comparative study of their properties. It does not appear to be of very general application and is very unreliable, at any rate as employed at present, in the case of the many elements which have a low vapour tension and which do not yield stable volatile compounds. In the case of these elements, attempts at direct fractionation remain the only means at present of investigating isotopism.

Any method of fractionating mixed elements must evidently be based upon the sufficiently accentuated non-identity of a given property of the isotopes. The first to be studied were naturally the chemical and electrochemical properties which, according to the older views, could not be the same for two elements of different atomic weights. All attempts hitherto made in this direction have always been a complete failure, and it is just this failure which has largely contributed to the development of the theory of isotopism. The failure led to the conclusion that only methods depend-

ing upon the atomic mass could lead to positive results. But in the light of certain modern theories this conclusion has largely lost its restrictive value. Actually in Rutherford and Bohr's model of the atom the mass of the nucleus would certainly have some influence, however slight, upon the configuration and frequencies of the outer electrons, so that even the properties, the origin of which is in the superficial layer of the atom, would show certain differences in two isotopic elements. At the present moment, our knowledge is not sufficient to enable us to foretell with certainty the magnitude of these differences. Hence a method of separation which is applicable to ordinary elements cannot *a priori* be regarded as absolutely useless in the case of isotopic elements. Experience has to decide in each special case.

Experience has already decided in the negative in the case of fractionation, based upon a difference of chemical affinity, electrochemical properties, solubility, vapour tension in the solid or liquid state. All these methods appear to be definitely abandoned to-day. On the other hand, special methods have been tried or suggested, and some of them have finally given, especially during the last two years, positive results which seem to be definitely established.

The attempts to separate isotopes, the results of which have been published in 1920 and 1921, have depended upon the three following methods:—

I. Action of Centrifugal Force.

II. Diffusion in the Gaseous State.

III. Evaporation under reduced pressure followed by an immediate condensation of the vapourised molecules.

The first of these methods is based upon the proportionality between the densities and the atomic weights of the isotopes. The efficiency of the method was discussed in 1919 by F. A. Lindemann and F. W. Aston, according to whom centrifugation of liquefied neon (regarded as a mixture of two isotopes of atomic weight 20 and 22), or of fused lead (regarded as a mixture of Pb U and Pb Th of atomic weight 206 and 208), performed in suitable conditions and

with a peripheric velocity of 10 cm. per second would lead to differences of the order of 0.5 per cent. between the densities of the portion nearest to and that furthest from the centre of rotation. The method was applied in 1920 by J. Joly and J. H. J. Poole to the separation of Pb Th and Pb U, the atomic weights and densities of which show a difference of about 1 per cent. The experiment was carried out with ordinary fused lead contained in steel tubes heated electrically placed upon a centrifuge turning 150 times per second. The tubes were 6 cm. long, the distance between the centre of rotation and the nearest extremity of the tube was 4 cm., which corresponds to a peripheric velocity of about 9.1×10 cm. per second. After an hour's centrifugation, the metal was rolled into spheres, as homogeneous in structure as possible, and the densities of the specimens thus obtained were compared by successive weighings in air and methyl iodide. The determinations of the density were made to 0.003 per cent. about. The results of five experiments showed that the sphere coming from the lower end of the tube was in three cases denser than that coming from the upper end (differences 0.05, 0.006, 0.01 per cent.), in one case it was less dense (difference 0.003 per cent.), and in one case the density was the same. These results indicate that no separation has been proved. The calculations of Lindemann and Aston referred to these experimental conditions would only foretell a difference of 0.005 per cent. between the two spheres. In spite of these negative results it is probable that the centrifugation method will not be abandoned. According to J. H. J. Poole, it will only be necessary to increase the velocity of rotation about seven times with the same experimental arrangement in order to obtain clearly detectable separations. In the case of mercury, for example, considered as a mixture of isotopes of atomic weight 200 and 204, in these conditions the differences of density obtained would be 0.15 per cent., and the calculated results are even more favourable in the case of neon.

(To be Continued.)

PHOSPHORUS IN CALIFORNIAN PETROLEUM.

CHASE PALMER.

Operators in oil fields already realise the importance of knowing something of the

composition of underground waters, but the general impression seems to be that nothing more is needed than a statement of the items employed to determine the fitness of a water for use in a steam boiler. Consideration of the composition of oil field waters is confined almost wholly to the major constituents of such soluble minerals as common salt, glauber's salt, gypsum and soda. Little evidence concerning the minor constituents of oil field solutions has been sought, and it is not surprising, therefore, that in the waters of the oil measures of California phosphates have escaped observation. If the prevailing opinion is correct, namely, that phosphates in all waters are derived only from the mineral, calcium phosphate, dissolved with difficulty out of the adjacent rocks and sands, then, of course, the minute quantity of phosphate possible in an oil field solution can have little significance and may well be disregarded. If, on the other hand, phosphorus can be found in the oil with which these subterranean solutions have been in contact, then the importance of knowing the phosphate content of an oil field water is apparent.

On a single section of the Sunset district, California, five well waters presumably from the same oil sands were found to contain phosphates in quantities ranging from 0.4 to 2.6 parts of phosphates (PO_4) in one million parts of solution. Although all of these solutions are primarily brines, some of them are modified chiefly by interaction with oil while others are mixtures containing also waters intruding from outside the oil measures. The persistence of phosphate in these waters suggested the possibility that phosphorus might also be present in the oil of that locality. Consequently a heavy oil from the same section that produces the phosphate solutions was closely examined and found to contain phosphorus to the amount of one one-hundredth of one per cent. of its weight. Another heavy oil drawn from a shallow well in the Kern River oil field also showed a phosphorus content of one one-hundredth of one per cent. This well has been producing oil for several years.

NITROGEN COMPOUNDS IN CALIFORNIAN PETROLEUM.

Phosphorus and nitrogen in the properties of their compounds resemble each other closely, and since nitrogen com-

pounds constitute a large part of a Californian crude oil, consideration of the chemical nature of these nitrogen compounds may throw light on the source of phosphates in oil field solutions.

Californian petroleum consists essentially of three very different classes of organic compounds, namely, hydrocarbons, hydrocarbons with sulphur, and hydrocarbons with nitrogen. The nitrogenous hydrocarbons are usually called organic nitrogen bases. Members of all of these classes are oxidizable, but their oily nature shields them from direct attack of inorganic oxidants mobile in the waters or fixed in the rocks. The organic nitrogen bases, however, form soluble salts with strong acids so that considerable quantities of these nitrogen bases are undoubtedly dissolved by the corrosive waters of the oil measures and the resulting solutions of organic nitrogen salts, necessarily in a state of high dilution, can offer little resistance to the attacks of oxidants. In 1899 Mabery¹ prepared a long series of organic nitrogen bases by digesting an oil from Santa Paula, California. More recently Mabery and Wesson² have shown that under certain conditions an inorganic oxidant, like potassium permanganate, oxidizes these organic nitrogen bases to organic nitrogen acids, while under other conditions ammonia is formed. Appreciable amounts of ammoniacal compounds and of organic nitrogen acids are therefore to be expected in a water closely associated with a Californian oil. The organic acids obtained by Mabery are derivatives of pyridine, an important constituent of bone oil produced by distilling the bones of vertebrates.

NITROGEN COMPOUNDS AND PHOSPHATES IN OIL FIELD WATERS.

Waters from the oil measures of the Sunset, Midway, Kern River and Coalinga fields were found to contain nitrogen compounds in the forms of free ammonium salts and of organic nitrogen acids, often in large amounts. These products conform to the products which Mabery and Wesson obtained by oxidizing the organic nitrogen

bases extracted from the oil from Santa Paula. Nitrogen compounds were not looked for in every water in which phosphate was known to be present, but whenever nitrogen compounds were sought in phosphate waters they were found.

A well that has been producing both oil and water in the Sunset district furnishes strong evidence that the oil has suffered powerful mineral oxidation. The water solution brought up with the oil and primarily a brine, itself somewhat modified by the mineral material which it has dissolved out of the rocks, was found also to contain free ammoniacal compounds as well as organic nitrogen compounds in amounts corresponding to 335 parts of ammonium chloride and 635 parts of organic nitrogen acids in one million parts of the solution. This water also contained 2.7 parts of phosphate per million.

The presence of phosphorus in Californian oils and the usual association of phosphates with the soluble oxidation products of organic nitrogen bases in the waters of the oil measures point to the oil as the source of these phosphates.

UNDERGROUND OXIDATION.

When nitrogenous organic matter decays under atmospheric conditions nitrites and nitrates are among the final oxidation products and surface waters polluted by decomposing organic matter often contain nitrogen in all the four forms that have been mentioned. It is a striking fact that these aqueous solutions brought up by the wells, solutions which have reacted with the oils underground and are charged with ammoniacal salts and organic nitrogen acids, have failed to show the presence of nitrates and nitrites. The organic nitrogen bases of the petroleum, therefore, normally suffer only partial oxidation underground, the limit of oxidation coinciding with the limit which Mabery and Wesson reached by oxidizing the organic nitrogen bases of Santa Paula oil with potassium permanganate.

Manganese dioxide and other oxides of manganese are freely distributed in the oil regions of California. With corrosive brines they would form soluble manganous chloride and halogen which by a cycle of well-known reactions easily produces active oxygen from the solution. Oil field solutions usually contain manganous chloride formed probably by the reduction of a manganic

¹Mabery, C. F., *Journ. Soc. Chem. Ind.*, vol. 19, 505 (1900).

²Mabery, C. F., and Wesson, L. G., "Constitution of the Organic Nitrogen Bases of California Petroleum," *Amer. Chem. Soc. Journ.*, vol. 24, 1014 (1920).

oxide by the organic nitrogen salts dissolved from the oil. Moreover, higher oxides of manganese seem to be easily accessible because the muds brought up with the oil and water often contain the dark oxides of manganese.

VENTURA EMULSION.

To learn whether the dual occurrence of phosphorus in oils and waters is peculiar to the oil measures of San Joaquin Valley examination was made of an emulsion¹ from the Ventura oil field close to the Pacific coast and about fourteen miles distant from Santa Paula. The permanent emulsion still contained 53 per cent. of suspended water and about 0.005 per cent. of mineral material that could not be removed. Manganese was found in this residue which had been held up in the emulsion.

The oil in this emulsion was found to contain phosphorus to the amount of 0.008 per cent. of its weight.

The water set free from the emulsion is a brine containing free ammonium salts and organic nitrogen compounds in abundance. A very small quantity of soluble manganous salt is also present. The water was perfectly free from nitrites and nitrates, but it contained as much as 5.2 parts of phosphate per million. The active

Supplied by Mr. B. H. van der Linden of the Shell Oil Company. ties in the Ventura oil measures are evidently like the activities in the oil measures of San Joaquin Valley.

The conclusions reached in this investigation are briefly stated in the following summary.

SUMMARY.

Californian heavy oils containing nitrogen bases have been found also to contain phosphorus.

These nitrogen compounds and phosphorus compounds may be oxidized by minerals through the agency of underground water solutions and without the help of atmospheric oxygen.

The association of phosphorus compounds with nitrogen compounds in oils of different fields is another link in the chain of evidence that Californian petroleum is of animal origin.

Eaton Laboratories, San Francisco.

¹Supplied by Mr. B. H. van der Linden of the Shell Oil Company.

NOTICES OF BOOKS.

(1) *Roger Bacon, the Father of Experimental Science*, by H. STANLEY REDGROVE, B.Sc., F.C.S. Pp. 63 + 1 plate. Price 1s. 6d.

(2) *Joseph Glanvill and Physical Research in the Seventeenth Century*, by H. S. REDGROVE, B.Sc., F.C.S., and I. M. L. REDGROVE. Pp. 94 + 1 plate. Price 2s.

London: Wm. Rider & Son, Ltd., 8-11, Paternoster Row, E.C.

(1) It was pointed out in the review of Mr. Redgrove's *Alchemy: Ancient and Modern*, which recently appeared in *The Chemical News*, that the lives of many of the alchemists were very interesting, and therefore this life of Roger Bacon by an author so admirably equipped to deal therewith is very welcome.

Roger Bacon was an original thinker, and in his ingenious speculations anticipated many modern discoveries, such as the telescope, microscope, etc. As a result, he has been erroneously credited with some of these discoveries, and a recently discovered MS. in cypher would appear to support the attribution. The authenticity of this MS. is very questionable, and Mr. Redgrove has done well in ignoring it and basing his estimate of Roger Bacon upon his undoubtedly authentic works. Bacon did make one discovery in experimental science, namely, that of gunpowder, but his claim to greatness does not rest on this, or on his ingenious speculations, but upon his remarkable grasp of the true nature of the method of science as a combination of experiment and mathematics.

The life of Roger Bacon, too, is interesting as an example of the contest between the spirit of science and that of tradition and authority. Mr. Redgrove has chosen an admirable theme, and has dealt with it in a masterly and most interesting manner.

(2) The work on Glanvill may not, perhaps, make so strong an appeal to chemists as that on Bacon, but it deals with the same theme of the conflict of science with the powers arrayed against it in times gone by. Joseph Glanvill was one of the earliest Fellows of the Royal Society. In those days the Society was looked upon with disfavour by those who were pledged to traditional beliefs. Glanvill rendered the Society and the cause of Science great service by his books and writings in defence of the new experimental philosophy.

Amongst his friends was the Hon. Robert Boyle, who took a great interest in his investigations in what we should now call psychic phenomena. In these investigations, as elsewhere, Glauvill exhibited the spirit of scientific enquiry, and the authors are justified in claiming him as the pioneer of Psychical Research. Glauvill's works deserve to be far better known, and we are indebted to Mr. and Mrs. Redgrave for this admirable account of them and their author.

The work on Bacon contains a reproduction of a photograph of Mr. Hope-Pinker's fine statue of Bacon, at Oxford, and that on Glauvill is illustrated with a reproduction of Faithorne's engraved portrait of Glauvill.
J. G. F. D.

An Inorganic Chemistry, by H. G. DENHAM, M.A., D.Sc., Ph.D. Pp. VIII. + 684. London: Edward Arnold & Co., 1922. Price 12s. 6d.

The number of textbooks on Inorganic Chemistry increases every year. It is doubtful whether many of the newer ones possess such outstanding merit, beyond containing more recent work, for them to displace extensively the earlier ones.

The necessity for correlation and classification of observations and facts is pointed out. These can be most surely impressed upon beginners with the aid of the Natural Laws of Science and carefully examined hypotheses.

In this book, the arrangement of the subject is based upon the Periodic Classification of the Elements. The groups of elements are considered upon this plan after a study of the Halogens.

The basic, amphoteric and acidic properties of oxides are emphasised in a manner calculated to produce a correct impression of the chemical properties of various elements.

The Ionic Theory is not introduced until late in the book. This has one advantage, apart from the historical development,

namely that the fundamental laws will have been previously mastered.

The final chapter gives a brief outline of the border-line subject of Radioactivity, and the important considerations of Physical Chemistry, *e.g.*, osmotic pressure, dissociation, the dilution law, thermo- and electro-chemistry, appear in their appropriate places.

Prof. Denham's book presents few strikingly original features, but is quite up-to-date and has evidently been carefully written. Also Messrs. Arnold are publishing it at a reasonable price, and it should therefore find favour in many schools and colleges.
J. G. F. D.

Proteins and the Theory of Colloidal Behaviour, by JACQUES LOEB. Pp. XI. + 292. London: McGraw-Hill Publishing Co., Ltd., 6 & 8, Bouverie Street, E.C., 1922. Price 15s.

It was Graham who first suggested the distinction between colloid and crystalloid bodies. When it was found possible for a substance to exist in solution in both conditions it was proposed to distinguish between colloid and crystalloid *states of matter*.

Now, Dr. Loeb maintains that the whole behaviour of what are termed colloidal solutions of proteins is in agreement with ordinary chemical laws, and that when a neutral salt is added to a gelatin solution the protein units in solution react with one ion of the neutral salt only. This view is contrary to that held by most colloid chemists, since it leaves out of account the adsorption effects.

The author's experimental work has been largely based upon Prof. Donnan's ingenious theory of the equilibria which are established when two solutions of electrolytes are separated by a membrane permeable to all except one ion. This theory has supplied a quantitative and mathematical explanation of the behaviour of protein solutions. Dr. Loeb shows that gelatin in solution is in a critical state when the hydrogen ion concentration is a certain definite amount, namely, $\text{pH} = 4.7$, which he

terms the iso-electric point. At this point the gelatin is non-ionised and does not show the phenomenon of cataphoresis.

On the acid side of this point, gelatin forms compounds in which it plays the rôle of a positive radicle in combination with negatively charged ions such as Cl^- , or OH^- . When ionised, the gelatin ion is positively charged.

On the basic side of the iso-electric

phenomena in the cyanide process.

Chapters are devoted to Flotation as applied to gold and silver ores, and numerous diagrams are given of the plant now used for cyaniding gold and silver and the methods of precipitation; technical details of great practical value, together with a number of illustrations, are included.

In an appendix at the end of the book of the researches of Dr. on the production of antidotes ng, and a set of tables is he cubical contents of its of various diameters

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SYNTHESIS.

ntesis of formaldehyde le has now been defi- d by Professor Baity, nce that such a process ce in the plant when converted into sugars. nation avoids the neces- rmaldehyde to be one of tages of photosynthesis. that:—

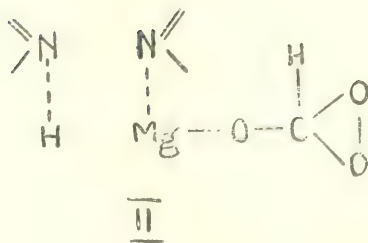
and water add on to (I. and II.).

inated (III.).

CHLOROPHYLL

THEORY OF PHOTOLOGICAL PRACTICE.

The work has been entirely re-arranged, and many additions have been made, the recent advances in the knowledge of colloidal chemistry and physics have been brought to bear upon the subject, and two important chapters are given dealing with the colloidal aspect of slimes and precipitates, and the part played by adsorption



Amongst his friends was the Hon. Robert Boyle, who took a great interest in his investigations in what we should now call psychic phenomena. In these investigations, as elsewhere, Glanvill exhibited the spirit of scientific enquiry, and the authors are justified in claiming him as the pioneer of Psychical Research. Glanvill's works deserve to be far better known, and we are indebted to Mr. and Mrs. P. Glanvill for this admirable account of their author.

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On the basic side of the iso-electric point, gelatin behaves as a negative radicle, combining with such positively charged ions as Na^+ or H^+ . When ionised the gelatin ion is negatively charged.

From his experimental results showing that gelatin combines with acids and alkalis according to the stoichiometrical laws, Dr. Loeb definitely assumes that proteins dissolve in water forming true solutions. He criticises Pauli's Hydration Theory of the behaviour of colloid solutions.

The book largely consists of the author's published and unpublished work on the subject, and cannot fail to attract the widest attention. Doubtless his views will be severely criticised in some quarters, but at least they constitute an important advance in the elucidation of the exact nature of colloidal phenomena. J. G. F. D.

Cyaniding Gold and Silver Ores, by H. FORBES JULIAN and EDGAR SMITH. Pp. XXIV. + 417. 3rd Edition. 1921. Charles Griffin & Co., Ltd. Price 36s. nett.

This well-known and valuable work on the Cyanide process of gold extraction has had an unfortunate history. One of the authors, Mr. H. Forbes Julian, met an untimely death by the foundering of the Titanic, and his colleague, Mr. Edgar Stewart, was murdered by natives in Africa in 1916. The war prevented an intended earlier revision.

The third edition now issued has been prepared by Mr. A. W. Allen, a well-known American authority on metallurgical practice.

The work has been entirely re-arranged, and many additions have been made, the recent advances in the knowledge of colloidal chemistry and physics have been brought to bear upon the subject, and two important chapters are given dealing with the colloidal aspect of slimes and precipitates, and the part played by adsorption

phenomena in the cyanide process.

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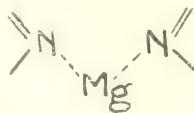
In an appendix at the end of the book an account is given of the researches of Dr. C. Martin upon the production of antidotes for cyanide poisoning, and a set of tables is included, giving the cubical contents of circular cyanide vats of various diameters and depths.

The work is well indexed and has a very complete table of contents.

PHOTOSYNTHESIS.

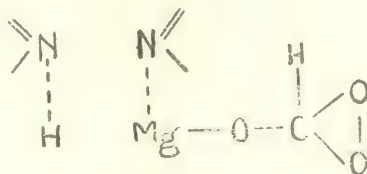
Although the synthesis of formaldehyde from carbon dioxide has now been definitely demonstrated by Professor Baly, there is little evidence that such a process actually takes place in the plant when carbon dioxide is converted into sugars. The following explanation avoids the necessity of assuming formaldehyde to be one of the intermediate stages of photosynthesis. It may be assumed that:—

- Carbon dioxide and water add on to the chlorophyll (I. and II.).
- Oxygen is eliminated (III.).

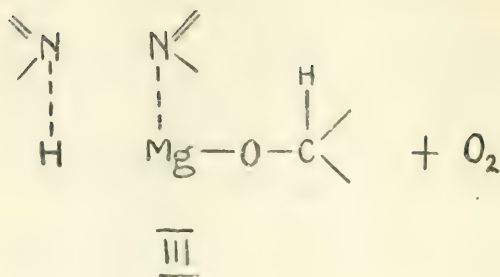


ACTIVE PART OF CHLOROPHYLL

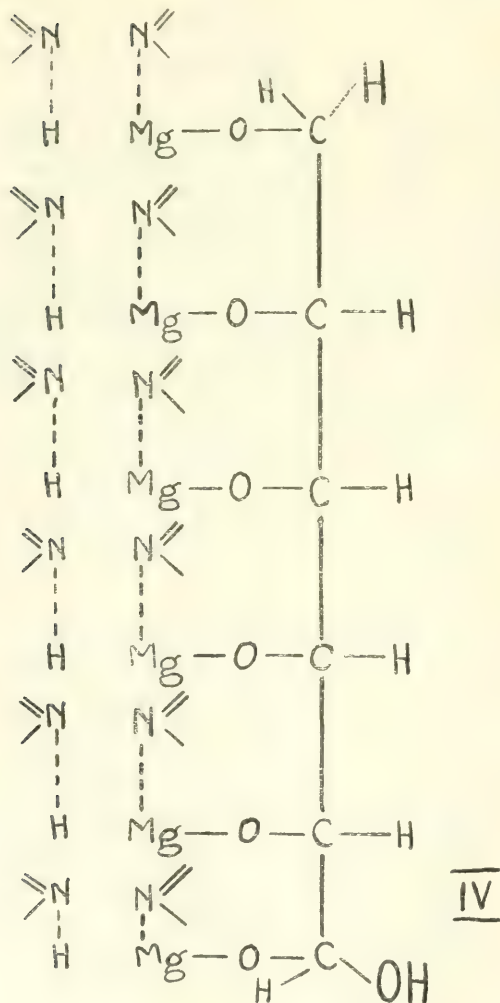
I



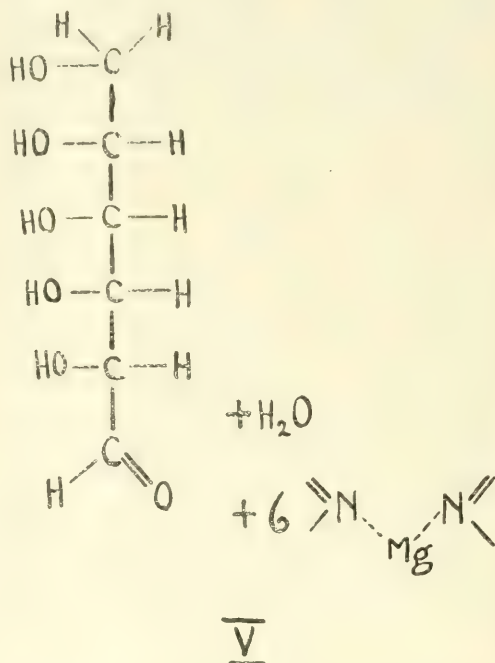
II



(c) Six molecules of the resulting product combine, water being added on (IV.).



(d) The compound IV. is immediately broken up, water is eliminated, and glucose formed, the chlorophyll being recovered unchanged (V.).



Such an interpretation also accounts for the appearance of only one optical isomer, instead of the racemic mixture which must result from the condensation of free formaldehyde to sugars.

It should be noted that the stages (a) and (b) have been already suggested by Fillstätter.

INSTITUTE OF CHEMISTRY STUDENTS' ASSOCIATION (LONDON).

At the recent first general meeting of the Association, Sir Herbert Jackson, K.B.E., F.R.S., Past President of the Institute, was nominated and unanimously elected first President of the Association. Mr. Marlow expressed Sir Herbert Jackson's regrets that before he had been approached on the subject of the Presidency he had made an appointment for that evening which he was unable to cancel; he hoped, however, on many future occasions, to be at the meetings of the Association, and had expressed his heartiest good wishes for its success.

GENERAL NOTES.

INTERNATIONAL INSTITUTE OF
AGRICULTURE, ROME.

PROSPECTS OF WHEAT CROP IN 1922.

From the Bureau of Statistics.

According to estimates communicated to the International Institute of Agriculture by the Governments of a group of countries representing about one half of the Northern Hemisphere wheat crops, their yield in 1922 is 39.5 million metric tons (exclusive of Russia). Compared with the production of the same group of countries in 1921 (36.9 million tons), there is an increase of 7 per cent. This increase is entirely due to the large crop in British India, which surpassed that of 1921 by 3.3 million tons.

In the United States the forecast is for a wheat crop slightly superior (by 3 per cent.) to the previous harvest (22.2 million tons as compared with 21.6 in 1921).

On the other hand, the European estimates of production are decidedly below those of 1921 as regards the few countries which have furnished data. Belgium, Bulgaria, Spain, Finland, Greece, Hungary and Poland give an aggregate of 7.2 million tons in 1922 against their returns of 8.2 million in 1921.

The information to hand from those countries not yet ready to furnish estimates may be summarised as follows: The June rains have somewhat improved conditions for the wheat crop in France, Italy and Czechoslovakia, while the position is fairly good in Bulgaria, Rumania and the Serb-Croat-Slovene State.

The condition of the Canadian wheat crop is reported as generally favourable, apart from some injury by strong winds and hailstorms.

DEFINITION OF RELATIVITY.

In the article on the above, July 21st. page 23, the last two lines of the second column were transposed. The author wishes the word "geometrical" inserted before the word "calculus" in the 12th line from the top of column 2, page 382, in the issue for June 30th last.

LETTER TO THE EDITOR.

[The Editor does not hold himself responsible for the opinions of Correspondents, which may or may not agree with his own.]

July 18th, 1922.

Rome, July, 1922.

SIR,—In view of Sir Robert Hadfields' recent estimate that the ravages of rust and corrosion represent an annual wastage of more than £500,000,000, I beg to draw your attention to the enclosed particulars regarding the Association of Manufacturers of Non-Corroding and Anti-Corrosive Products, which is being formed in order to create new and increased demands for the products and processes of its members.

The following firms have already intimated to me that they are in accord with the formation of such an Association:—

Messrs. Arthur Ross, Hotchkiss & Co., Ltd., boiler preservatives; Messrs. Cuirass Products, Ltd., anti-corrosive paints; Messrs. Henry Wiggin & Co., Ltd., nickel refiners; Messrs. Meldrums, Ltd., acid-resisting chemical plant; Messrs. Thomas Firth & Sons, Ltd., stainless iron and steel.

A meeting will be called as soon as all members of the trade have been approached with a view to being associated as founders of the movement, and the early attention to this matter by any manufacturer will be appreciated.—Yours, &c.,

W. R. DOUGLAS SHAW.

c/o The Royal Society of Arts,
18, John Street, Adelphi,
London, W.C.2.

The objects of the proposed Association and all other particulars can be obtained by application to W. R. Douglas Shaw as above.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs can be obtained gratuitously.

Latest Patent Applications.

- 17720 Bloxam, A. G. Manufacture of arylesters of phosphoric acid. June 27.
 17806 Elektrizitätswerk Lonza. Manufacture of metaldehyde. June 28.
 18074 Imray, O. Y. Manufacture of aryloxy-naphthylketones. June 30.

Specifications Published This Week.

- 160143—Ampere Ges. Rothe, Dr. E., and Diefenthaler, Dr. O.—Process for the manufacture of molybdenum metal or iron molybdenum alloys.
 181486—Cederberg, I. W., and Backstrom, H. M.—Method of the catalytic oxidation of ammonia with oxygen.
 181509—Gleitz, W.—Process for removing free acids from glycerides
 181512—Elektrizitätswerk Lonza, and Busch, A.—Burner for burning metaldehyde.
 166887—Niedenzu, Dr. K.—Manufacture of artificial nitrogenous fertilizers.

Abstract Published this Week.

179586.—Phenol-formaldehyde condensation products.—Petersen, W., 6, Lloyds Avenue, London, and Clarke, E. V., 56, St. Annes Crescent, Lower Sussex.

An initial liquid condensation product, formed by reaction of phenol with formaldehyde or trioxymethylene in the presence or absence of basic catalysts, is mixed with over 5 per cent. of an organic carboxylic acid, such as lactic, acetic, formic acid, without any mineral acid, and the mixture is heated until it becomes a viscous liquid which does not adhere to a metal surface. This product, or a solution thereof in alcohol or other solvent, is mixed with a filler, such as asbestos, wood flour, or china clay, to give a plastic mass which can be pressed in moulds. The moulded articles are subsequently converted into hard infusible products by heating. Specification 156,675 is referred to.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

UNIVERSITY OF BIRMINGHAM.

FACULTIES.

Science: Subjects—Mathematics, Physics, Chemistry, Zoology, Botany, Geology, Engineering (Mechanical, Civil, Electrical), Metallurgy, Mining (Coal, Metal, Petroleum), Bio-Chemistry of Fermentation.

Arts: Subjects Latin, Greek, English, French, German, Italian, Spanish, Russian, Philosophy, History, Music.

Medicine: All subjects leading to Degrees and Diplomas in Medicine and Dentistry.

Commerce: Subjects leading to Degrees in Commerce.

Department of Training for Teachers:
Department of Social Study:

Department of Malting and Brewing.

THE SESSION 1922-23 COMMENCES
ON OCTOBER 2nd, 1922.

ALL COURSES AND DEGREES ARE
OPEN TO BOTH MEN AND WOMEN
STUDENTS.

In the Medical School, Courses of Instruction are arranged to meet the requirements of other Universities and Licensing Bodies.

Graduates, or persons who have passed Degree Examinations of other Universities may, after one year's study of research, take a Master's Degree.

Separate Syllabuses with full information as to Lecture and Laboratory Courses, Fees, Regulations for Degrees, Diplomas, etc., Exhibitions and Scholarships, are published as follows:—

1. Faculty of Science.
2. Faculty of Arts.
3. Faculty of Medicine.
4. Faculty of Commerce.
5. Department of Social Study.
6. Department of Biology and Chemistry of Fermentation.
7. Exhibitions, Scholarships, etc., and will be sent on application to the Registrar.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3251

SPORTSMANSHIP IN BUSINESS AND PUBLIC LIFE.

[An Address delivered at the School of Mines and Metallurgy, University of Missouri, by Col. Albert T. Perkins.]

In thinking over what message I might bring to you from the experiences of a rather active career, two factors in making a successful life came into my mind—loyalty and sportsmanship. I decided to talk to you about sportsmanship.

Perhaps you have been used to thinking of sportsmanship as the spirit of fair play in sports or games. But sports and games have all developed as imitations of or idealizations of phases of serious life. The latter is true too of all of our intellectual pleasures—the drama, music, art.

You and I have played various games. These games in their present form are the result of centuries of development. Some of you have been hunters, and you have in your mind the distinction between the sportsman hunter and the pot hunter.

You have been playing your games as amateurs. Now you are going to play a bigger game as professionals. The difference between an amateur and a professional is not one of sportsmanship. The idea of the professional is connected up with the necessity of earning one's food and clothes.

Dr. Spaeth—a fine type of sportsman and a rare combination of coach of the rowing crews and Professor of English Literature at Princeton—was saying the other day (as I remember it), "don't go into a game you can't afford to lose; but when you are in the game play it as if you couldn't possibly afford to lose it."

Well, that is sound from the point of view of a game as play. But what you are coming to now is, in baseball language, a long "series," and it will be the "series" which you can't afford to lose, and mustn't lose.

A young athlete wrote to Major Henry Lee Higginson after the latter's inspiring address in dedicating Soldier's Field in June, 1890—"It matters but little the week after, whether a boat race or a football match be won or lost; but let a man or a team do but a single thing which is not

entirely manly and aboveboard, and it sets them back in the real race perhaps for years."

So as you come to the commencement of the real race I made my subject "Sportsmanship in Business and Public Life."

The old adage that "All's fair in love and war" is a relic of the savage state. Treachery is something we at once attribute to the savage or to those in whom the instincts of the savage predominate.

Sportsmanship—fair play—is entirely a product of civilisation, frequently being reverted from here and there, but always in the long run spreading and growing in intensity. Doubtless it influenced war before it did business or civil administration. In the times of those famous sportsman warriors, The Cid Rodrigo de Bivar, Richard Cœur de Lion, and the Chevalier Bayard, it went by the name of "Honour."

You don't expect to take part in a war. Neither did I when I graduated from college. But before I pass to civil business, let me quote you one passage from a sportsman soldier.

The French General, Baron de Marbot, describing in his Memoires the trick played by Marshals Lannes and Murat on the Austrian General, d'Auersperg, in getting hold of the Spitz bridge over the Danube before the battles of d'Essling and Wagram in 1905 (which he estimated would otherwise have cost 30,000 men) says (my apologies to him for my translation): "But was the stratagem of which they made use admissible? I don't think so. I know that in wars between State and State one stretches his conscience under pretext that everything which assures victory may be employed in order to diminish the losses of men, all in giving great advantage to one's country. Still, in spite of these serious considerations, I don't think one ought to approve the means employed to seize the Spitz bridge; as for me I would not do it in like circumstances."

The Sportsman in Business—the man of square dealing, of fair play, who has the coolness to meet unperturbed all emergencies! It seems to me a most fundamental requirement is a thoroughly clear realisation that no valid excuse exists for a departure from one's own ideals and rules of conduct, in the knowledge or belief that the other fellow is doing it. That is something where one is often getting into a fog—a mist which arises around one's relations to his employees, to the public, to his business competitors, and to the government.

You may be engaged in what might be called independent professional work, or in the employ of public utilities. But in the past thirty-five years our Government (National and State) has been establishing an increasing control over all business and professional activities. It has been making rules by which the business game is to be played. Many experiments have been tried and many errors made, just as in the development of the football or baseball rules.

Yet there has been undoubted advance in the soundness and fairness of rules made by the government; though the peculiarity of this situation is that as a whole, government in respect to fair play has followed instead of leading.

One might naturally expect that Government would set a good example of fairness in business dealings; but unfortunately many of those handling business affairs of governmental departments have not been brought up in principles of business sportsmanship and their transactions (not for personal gain, but for their departments) have often been of a character abhorrent to the majority of business men.

There seems to be some reaction in that respect, for business men of character and experience are gradually taking more part in governmental affairs.

Now the Government has to come in as a rule maker in business and public utility affairs because the minority would not otherwise play fairly, and the rules had perhaps to weigh heavily both on the fair and unfair players.

It is 35 years since the Interstate Commerce Law was passed. In its early days that was broken in all directions. It took years, with the addition of many modifications and penalties, to make its rules thoroughly effective. The explanation of its violation in any case was almost always that it was to meet the violation by somebody else.

Since then we have had a series of regulatory laws affecting almost all classes of business; and there is a great advance in the willingness and the desire to obey them.

Within this period there has been another marked advance from a widespread feeling among business men that municipal legislators were for sale and had to be purchased even in matters of much concern to the public. The business men who lead have become too good sportsmen nowadays

to fall into that sort of thing or to tolerate it on the part of others.

One often hears the statement that railroads and public utilities and other large business corporations have brought their troubles on themselves, coupled sometimes with expressions of sympathy, now that they are trying to do better. But has it not been that the rules were in the making and loose and not enforced by competent umpires and referees; and that those who have worked as sportsmen have frequently been upset by blows below the belt? And the public did not and could not understand all the rules.

The public is always calling for more and better service from its utilities, and properly so. It wants it, too, as cheaply as it can get it. But the public does not and cannot generally understand all the conditions underlying the production of such utilities and the cost of their operation.

On the other hand the managers of most utilities are nowadays doing their utmost to give the public the best service to which their means will stretch.

It seems to me that one of the greatest advances in the matter of fair play has of late years come as in our state, in the transferring of the control and regulation of public utilities from municipalities with their political turmoil and changing policies to a state commission where, whatever its defects, codes of principles and rules may be developed and the rights of both the served and the servers calmly considered.

You still hear and read statements that rates charged by public utilities are high because the utility companies are over-capitalised, i.e., have so-called "watered stocks."

Those statements are based on an entirely wrong impression of the present situation.

Formerly these public utility rates were fixed by local franchises—as 75 cents for gas or 5 cents for street car service. Whatever may have been the effect on confiding investors, it then made no material difference to the public served whether the capitalisation of the serving company were fifty million dollars or one hundred million dollars or one hundred and fifty millions, until such time as the public began to demand more and better service than could be produced for those fixed franchise rates.

Now that is just what the public began demanding. The old franchise rates ceased to meet the requirements, but with their

casting aside, went also any right to a new basis of rates in excess of what should produce a fair rate of return on a fair valuation of the serving property, irrespective of what its former capitalisation may have been—rates sufficient and only sufficient to pay the cost of producing the quantity and quality of service demanded by the public served.

This producing cost—wages, materials, taxes, and a fair return on a fair valuation of the serving property—the last and in the long run the first of these factors in the hands of a State commission representing the people but removed from local influences and prejudices and subject only to review by the courts. The factor of taxes remains in no small degree in the hands of the local communities themselves.

This matter of valuation of existing properties has features of great complexities and requires the exercise of the highest degree of wisdom, judgment, and the spirit of fair play on the part of the commissioners; for the valuation now is for fair rate-making purposes. It is the duty of the Commission under the law to make *fair* valuations—not unduly low, not unduly high. As time goes on this task will be simpler, for all issuance of new securities for additional capital investment in public utilities is now under control of the Commission.

Now I have said that in the long run the first factor—wages—is also really under control of the commission, and here it seems to me our spirit of fair play should in the highest degree come into action. This factor usually represents half or more of the rates charged the public. With the cost of material fixed from time to time by market conditions which Commissions cannot at least as yet control, with the valuation or new capitalisation and rate of return fixed by the commission, and the taxes fixed by government authorities, the public may know what it is paying for, and the actual rates of charge for service must depend primarily on the rates of wages (the degree of efficiency being taken fully into account); or vice versa the rates of wages must depend on the charge the utility is permitted to make for service.

So here we have the most serious of all problems—the balance of the rates of wages for the various classes of employees serving the public, as between those receiving the wages and the public who pay them.

In a way there is a satisfaction in this situation as it now exists. It brings out

clearly that if they play fairly the employees of a public utility must give the very best service they are capable of to the public, and the public through their representatives must in return provide for the payment of an adequate and even liberal reward.

You are going into business at a time when an uncomfortable process of readjustment of wages and prices is still going on—a time when there is the greatest need on the part of all concerned for a spirit of fair play.

Everybody who works faithfully is justified in asking the highest reward he honourably and fairly can obtain for his services; but it is hard to look at these matters from an unprejudiced point of view when one's own private interest is involved. And present conditions are complicated by the fact that in the hurry and stress of war conditions adjustments of wages did not come to all crafts and occupations on an even or proportionate basis.

I find myself in an interesting position at the head of a little army of 6,000 public utility servants, with bad actors for the most part weeded out, and with most of these 6,000 trying their best to do a good job for the public.

In the latter part of 1921 we had, in order to keep within our resources, to make some considerable reductions in wages from the high peak established in 1920. These were made in different degrees in different crafts, after long but amicable conferences and discussions with the committees of those involved, on scales which a combination of several circumstances seemed to make just.

But I am attacked by persons in public life wishing to curry favour with the unthinking sections of the public; but knowing nothing of the comparative deserts or requirements or the so-called working conditions of the employees involved, for not making further and deeper cuts in the wages of employees so that already low rates of fare charged to the public may be further reduced.

So I can't help feeling a greater satisfaction in being in a position where I am on behalf of my men defending against assault wage scales which have been adjusted on a fair basis and which have been approved by a court, instead of fighting for the last possible reduction.

In no way will you gain greater success in the long run than in being real sports-

men in treatment of those under your charge—with fairness, frankness, firmness. Most men will go a long way to meet you when they think you are square, and will respond to frankness. For example, we check all our conductors every month. We tell them they are going to be checked and explain why—so that we can know they are all right as the handlers of money. They don't know when they are being checked but they can always see the results afterwards. They understand it and no longer worry about spotters spying on them. It is all right when they understand they are simply audited unawares or without knowing just when, just as a bank teller or a post office clerk is.

Remember that it is up to you to set an example of and to teach sportsmanship to those who haven't had your training and advantages.

We haven't needed any for a long time, but we used to have a number of so-called grievance arbitration cases. In one of those a certain minister of the highest character was agreed on by both sides as arbitrator. There was really no doubt about the guilt of the man whose case was in dispute, and the arbitrator so decided. But the head of the guilty man's organisation could see only his own side—to protect one of his constituents and in mailing to the arbitrator a check for his organisation's half of the fee, he enclosed with it a note reading, "God help you as a minister!" Well, that showed bad sportsmanship; but he didn't know any better. Afterwards this labour leader learned better and expressed regret for some things he had said and done.

So you must have patience with these things, continually watch that your own skirts are clear, and results will come.

The most successful and most lasting results come where the dealing is square. That's where, for example, the shining reputation of the A., T. & S. F. Ry. organisation comes from—the outstanding sportsmanship (fairplay, courage, imperturbability) of the late E. P. Riley, impressed on his associates and carried on down through the entire organisation.

So what I preach to you is to carry into your business and professional and public careers the spirit of sportsmanship which has become second-nature to you in your games. No matter how foggy the conditions are, stick to the rules. If you find a

rule is wrong try to get it changed in the orderly way.

Give the other fellow, especially anybody under you, all the credit that is coming to him. You will probably get enough credit and more in the long run, enough to balance all the hard knocks and kicks and misrepresentations which you are also sure to get.

Last winter we had a dinner at our St. Louis Harvard Club for one of our Cambridge football coaches, and it did one's heart good to join in the rousing cheers given for Aldrich, captain of the Yale team—our perennial antagonist, as a fine sportsman and a clean player "without reproach." That is the spirit!

ALUMINA.

HYDROLYSIS OF ALUMINUM SALTS.

By Wilder D. Bancroft.

(From the *Journal of Physical Chemistry*, June, 1922.)

Over a century ago, Gay-Lussac¹ found that if one heats a solution of aluminum acetate, it soon becomes turbid and a large amount of alumina precipitates. If the solution is allowed to cool, the precipitate dissolves slowly and becomes transparent. On the reheating and recooling these changes repeat themselves, and this can be kept up indefinitely. With a dilute solution of aluminum acetate the turbidity begins at about 50° and a precipitate forms at a little higher temperature. The precipitate must change gradually because it dissolves more slowly, when the solution is cooled, the longer the heating has lasted. With a more concentrated solution of aluminum acetate the temperature must be raised somewhat higher before turbidity occurs; but this solution also clears up when cooled.

"To determine the amount of alumina precipitated from an acetate solution by heating and the variation with the temperature, there were taken two equal portions of aluminum acetate made by mixing in the cold two solutions of alum and of lead acetate. One of these portions was raised to the boiling-point and filtered at once, while the other portion was precipitated by ammonia. The two precipitates were washed and dried; after which it appeared that the first weighed about half as much as the second.

¹ *Annales de Chimie*, 74, 193 (1810).

"These observations may be very important for the makers of dyed fabrics, for they use the hot solutions of alum and lead acetate in order to get as concentrated solutions of the mordant as possible. A great deal of alumina must precipitate, and the loss will be considerable if the solution is filtered at once. To avoid this it is necessary to let the solution cool completely before filtering or decanting off the mother liquor, and it is also necessary to stir vigorously so as to be certain that all the alumina redissolves. Unless these precautions are taken, the aluminum acetate will be very acid, which is probably the reason for usually adding chalk. It is nevertheless easy to prevent the precipitation of alumina when an aluminium acetate solution is heated, by adding alum. As is well known, alum dissolves alumina and therefore keeps the solution of aluminum acetate from becoming turbid. A large excess of acid will accomplish the same result."

"The precipitation of alumina on boiling and the redissolving at a lower temperature are facts which are of interest to the general theory of chemistry, and which are rather exceptional. If the precipitation were due to volatilization of the acetic acid, the alumina would not redissolve when the temperature is lowered. As a matter of fact similar changes can be observed in a strongly acid solution or in hermetically sealed flasks. Since the precipitation does not depend on the volatilization of the acid, it is evident that it is due to the heat which wrenches apart the molecules of acid and alumina, carrying each out of the sphere of action of the other, and causing their separation. With less heat the same molecules come within each other's sphere of activity and combine."

Gay-Lussac is practically saying in other words what we now designate as reversible hydrolysis. In 1854 Crum¹ prepared colloidal alumina from a weaker and more basic solution than that used by Gay-Lussac. "By the continued action of heat on a weak solution of binacetate of alumina, $\text{Al}_2\text{O}_3(\text{CH}_3\text{CO}_2)_4(\text{OH})_2$, a permanent separation of the constituents of the salt takes place, although no acid escapes and no alumina is precipitated. The properties of the alumina are at the same time materially changed. A solution of binace-

tate of alumina diluted so as to contain not more than one part of alumina in two hundred of water, was placed in a closed vessel which was immersed to the neck in boiling water, and kept in that state day and night for ten days. It had then nearly lost the astringent taste of alum, and acquired the taste of acetic acid. Being afterwards boiled in an open capsule, acetic acid was freely given off, and when the boiling had continued about five hours (the loss of water being continually restored), the liquid was found to have retained not more than one-eleventh of its original quantity of acetic acid, or about one equivalent to five and a half of alumina."

The theory of this is very simple. Water will hydrolyze any salt until the product of the concentrations of the hydrogen and hydroxyl ions reaches a value of about 10^{-14} . If either base or acid is very sparingly soluble, the hydrolysis will run farther than if both are strong electrolytes. Equilibrium will be reached much more rapidly if the solution is heated. Whether the insoluble base precipitates or remains in colloidal solution will depend on the conditions of the experiment. That hydrolysis has taken place can be shown in a number of different ways. Gay-Lussac deduced it from seeing the precipitated alumina, and Crum from the change in the taste of the solution. One could measure the change in acidity in other ways than by the sense of taste. Debray² showed that if a dilute solution of ferric chloride is heated to 70° it no longer reacts with potassium ferrocyanide to form Prussian blue. The reason for this is that there is no more ferric salt in solution, it having been converted completely into colloidal ferric oxide. Colloidal ferric oxide is not blackened by hydrogen sulphide. On the other hand it is precipitated from apparent solution either by sodium sulphate or by sulphuric acid, a behaviour which is distinctly not characteristic of ferric chloride. Wiedemann³ has used the magnetic properties as a means of following the hydrolysis, because the atomic magnetism of the iron in colloidal ferric oxide is only one-fifth that of the iron in a strongly acid solution of ferric chloride. Colloidal solutions of the hydrous oxides can be obtained by hydrolysis of the

¹*Comptes rendus*, 68, 913 (1869).

²*Pogg. Ann.*, 135, 218 (1868); *Wied Ann.*, 3, 45 (1878).

³*Jour. Soc. Chem. Ind.*, 2, 537 (1883).

¹*Jour. Chem. Soc.*, 6, 225 (1854).

acetates, nitrates, or chlorides; but not in general by hydrolysis of sulphates, because sulphuric acid precipitates the colloidal solutions more readily than does hydrochloric, nitric, or acetic acid.

In 1883 Liechti and Suida published some work on the hydrolysis of solutions of aluminum salts. Their original paper is not in the John Crerar Library, the Library of Congress, or the Library of the Franklin Institute. I have therefore made use of the lengthy abstract by J. J. Hummel.¹ With aluminum sulphate ($\text{Al}(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$, 200 g per litre) there was no visible hydrolysis on heating or on diluting. With $\text{Al}_2(\text{SO}_4)_3(\text{OH})_3$ made from 200 g $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O} + 31.82$ g Na_2CO_3 per litre, there was no visible change on heating; but a precipitate formed when the solution was diluted fourteenfold. With a solution three-quarters as concentrated, there was no visible change on heating, but dissociation took place on diluting tenfold. Since three-fourths of fourteen is ten and a half, this shows the error in determining the beginning of visible hydrolysis. With time. The general results are that hydrolysis takes place more readily on heating and $\text{Al}_2(\text{SO}_4)_3(\text{OH})_3$ made from 200 g $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O} + 45.7$ g NaHCO_3 per litre a jelly was formed on heating and a precipitate remained on cooling. Diluting to one-half caused a precipitate to appear in the cold. With $\text{Al}_2(\text{SO}_4)_3(\text{OH})_4$ made from 300 g $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O} + 151.3$ g NaHCO_3 per litre, the solution kept only a short on diluting, the more basic the solutions. The statement is made that sodium sulphate accelerates the dissociation. If this is true, it must be because the sodium sulphate decreases the hydrogen ion concentration by reacting with the sulphuric acid to form acid sodium sulphate. Since sodium sulphate coagulates colloidal alumina, it may be that it has practically no effect on the hydrolysis; but causes the precipitate to become visible sooner. In other places Liechti and Schwitzer² say that they have proved that sodium sulphate retards the decomposition. There must be a misprint somewhere. A retarding of the decomposition would be more in line with the observation by Schmid that sodium sulphate retards the precipitation of alumina by sodium carbonate.

With what they call a sulpho-acetate, $\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)_2$, made from 200 g

$\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O} + 227.6$ g $\text{Pb}(\text{CH}_3\text{CO}_2)_2$ per litre, a precipitate formed on heating to 90° and a jelly on heating to 100° . The solution cleared up on cooling. There was no precipitate on diluting sixty-fold. On adding sodium bicarbonate to this so-called sulpho-acetate, Liechti and Suida obtained solutions of what they called basic sulpho-acetates, from $\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)_3(\text{OH})$ down to $\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)(\text{OH})_3$. There is no real reason for assigning these formulas to these solutions. In the first place there is no obvious reason why the sodium bicarbonate should take acetate rather than sulphate out of the aluminum salt. It would be distinctly more reasonable to consider the basic compounds as varying from $\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)_4(\text{OH})_2$ to $\text{Al}_2(\text{CH}_3\text{CO}_2)_3(\text{OH})_3$. Probably the reason for not doing this was that these solutions did not behave like basic acetate solutions obtained by adding sodium bicarbonate to aluminum acetate; but that does not prove anything because these latter solutions do not contain sodium sulphate. In the second place there is no reason to suppose that Liechti and Suida ever had a sulpho-acetate solution. The so-called sulpho-acetate solution was undoubtedly merely a mixture of $\frac{1}{3} \text{Al}_2(\text{SO}_4)_3$ and $\frac{2}{3} \text{Al}_2(\text{CH}_3\text{CO}_2)_3$. Similarly there is no satisfactory evidence of the existence of any of the alleged basic compounds. They may perfectly well have been aluminum sulphate or aluminum acetate or a varying mixture of both with peptized alumina. Liechti and Suida undoubtedly thought they were dealing with true basic salts because of their getting an apparent solution; but it is quite evident, even from the abstract, that they knew nothing about colloidal solutions. The formulas which are written therefore indicate the relative amounts of sodium bicarbonate which have been added to the original solution and nothing more than that. This point seems to have been overlooked by all the people who have discussed this work.

The so-called basic sulpho-acetates all formed jellies on heating and all formed precipitates on dilution, the temperature at which the first turbidity occurred being lower the more basic the solution. Less water had to be added to cause precipitation as the solution became more basic. With straight aluminum acetate, made from 200 g $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O} + 341.4$ g $\text{Pb}(\text{CH}_3\text{CO}_2)_2$ per litre, there was no turbidity on heating and no precipitation on cooling. This result does not contradict that of Gay-Lussac because he was work-

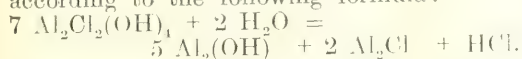
¹Mitt. techn. Gewerbe-Museums in Wien,

²Sektion für Färberei, 3, 59, 60 (1886).

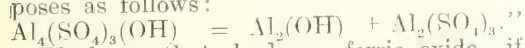
³Jour. Soc. Chem. Ind., 14, 654 (1895).

ing with a more dilute solution. All the so-called basic aluminum acetates formed precipitates or jellies on heating which did not dissolve when the solutions were cooled. The one with the alleged formula $\text{Al}_2(\text{CH}_3\text{O}_2)_4(\text{OH})_2$ precipitated on dilution; but the more basic ones did not. This may only be a question of a time factor. If not, sodium acetate must peptize alumina strongly.

By adding sodium carbonate to aluminum chloride, solutions were obtained having the analytical compositions, $\text{Al}_2\text{Cl}_5(\text{OH})$, $\text{Al}_2\text{Cl}_4(\text{OH})_2$, $\text{Al}_2\text{Cl}_3(\text{OH})_3$, $\text{Al}_2\text{Cl}_2(\text{OH})_4$. None of these solutions become turbid either on heating or on diluting. Liechti and Suida were not able, however, to make these alleged solutions synthetically. "The solubility of aluminum hydrate in aluminum chloride was tested, and the following remarkable results were obtained. To a solution of Al_2Cl_3 a quantity of aluminum hydrate was added sufficient to form the basic salt $\text{Al}_2\text{Cl}_4(\text{OH})_2$. The alumina dissolved only on heating, and the solution remained clear on cooling. To this clear solution a further quantity of aluminum hydrate was added, sufficient to form the compound $\text{Al}_2\text{Cl}_2(\text{OH})_4$. It was, however, found that no more alumina could be made to dissolve, the precipitate even increasing, and on filtering it was found that the solution contained equal molecules of normal Al_2Cl_3 and of HCl . The nascent $\text{Al}_2\text{Cl}_2(\text{OH})_4$ had apparently decomposed according to the following formula:



In the same way it was proved that, on adding aluminum hydrate to $\text{Al}_2(\text{SO}_4)_3$ solution sufficient to produce the basic compound $\text{Al}_4(\text{SO}_4)_3(\text{OH})$, no alumina at all dissolved, the filtrate only containing $\text{Al}_2(\text{SO}_4)_3$. Here, too, we must suppose that the nascent basic compound decomposes as follows:



We know that hydrous ferric oxide, if present in excess, will remove from suspension all the chromic oxide¹ peptized by caustic alkali; but nobody has studied the removal from suspension of a substance by an excess of itself, unless perhaps we have such a case in the Bayer process for the purification of alumina. Since Liechti and Suida were obsessed with the idea of basic compounds, they made no experiments to see whether addition of sodium chloride would cause more alumina to go into ap-

parent solution. According to Schmid¹ sodium sulphate retards the precipitation of alumina.

A whole series of so-called basic nitrate solutions were made up by adding sodium bicarbonate to aluminum nitrate solutions. None of these solutions became turbid either on heating or on dilution. The sum total of all these experiments is that basic aluminum acetate solutions hydrolyze very readily because the resulting acetic acid is a weak acid; that basic aluminum sulphate solutions become turbid because of the coagulating action of the sulphates, this more than counterbalancing the effect due to the strength of sulphuric acid; and that basic aluminum chlorides and nitrates do not become markedly turbid because the acids are strong ones having low coagulating powers.

Although Liechti and Suida got no cloudiness with their aluminum sulphate solution on heating, that may have been a question of concentration or of time, for Naumann² reports that "when a solution of potash alum is heated to the boiling point of water, a white precipitate is formed, which, after washing with water, is an amorphous powder, with an admixture of glittering laminæ, and dissolves with difficulty in strong hydrochloric acid, but easily in potash. The precipitate contains 31.2-32.6 per cent. of alumina, about 11 per cent. of potash, 30-40 per cent. of sulphuric acid, and water; and is therefore a more or less basic compound of alumina, potash, and sulphuric acid, with water. It was found that with pure alum solutions the decomposition was most rapid at first, gradually becoming less for equal intervals of time, so that a state of equilibrium in the liquid was reached only after a very long time. Dilution of the solutions favoured decomposition. Free sulphuric acid, added to alum solutions, prevented the decomposition, partially or entirely, according to the amount added. Neutral potassium sulphate, on the contrary, expedited the decomposition."

There is a good deal of uncertainty as to what compounds are formed when salts of aluminum are boiled or are treated with soda. Cajar³ states that the action of soda on cold aluminum sulphate solution gives a white precipitate which covers well;

¹ *Jour. Soc. Chem. Ind.*, 14, 654 (1895).

² *Ber. deutsch. chem. Ges.*, 8, 1639 (1875); *Jour. Chem. Soc.*, 29, 682 (1876).

³ *Zeit. angew. Chem.*, 27, 793 (1911).

¹ Nagel: *Jour. Phys. Chem.*, 19, 331 (1915).

whereas a more transparent precipitate is obtained when the soda is added to a hot sulphate solution. Underwood¹ states that alumina precipitated cold with sodium carbonate contains basic sulphate and dries soft and powdery; but that it dries horny when precipitated hot. Jennison² says that the hydrate of aluminum, $\text{Al}_2(\text{OH})$, "is produced when caustic soda or potash, ammonium hydrate or carbonated alkalies is added to a solution of an aluminum salt; it is soluble in caustic alkalies, and therefore is usually obtained by means of the carbonates. When produced from cold, dilute solutions, it is of a transparent, gelatinous nature; but, on heating, becomes opaque and more contracted in bulk. With carbonated alkalies it is must denser and is very lumpy, owing to the reaction being incomplete. Aluminum hydrate, when dried, forms a hard, white, horny substance, which has the composition of $\text{Al}_2(\text{OH})$, and only on ignition is the whole of the water driven off, leaving Al_2O_3 ."

According to Knecht, Rawson and Loewenthal a crystallised basic sulphate, $\text{Al}_2(\text{SO}_4)_2(\text{OH})_2$, has been placed on the market by Messrs. Peter Spence and Co., Ltd. Schlumberger⁴ claims that there is one basic sulphate of aluminum. On adding 4.5 mols of caustic potash to a solution containing one mol of aluminum sulphate, the supernatant liquid was still distinctly acid. On adding 5 mols KOH the solution was neutral and contained no aluminum salt. On adding 6 mols KOH the supernatant liquid was alkaline and contained some alumina, presumably as potassium aluminate. The precipitate must therefore analyse for $(\text{Al}_2\text{O}_3)_2\text{SO}_3\chi\text{H}_2\text{O}$ where χ is not less than six. Actually it came out seven, so Schlumberger writes the formula of the basic salt $(\text{Al}_2\text{O H})_2\cdot\text{H}_2\text{SO}_4$. Of course, it will be noticed that he analysed a precipitate obtained only under one set of conditions. While it may be that he was dealing with a definite compound, there is nothing in his experiments to prove it. He should have analysed the precipitate after adding three or four mols of caustic potash and have shown that it had exactly this

same composition. Then his results could have been accepted as proving something. This is the more necessary because many basic aluminum sulphates are to be found in the books.¹ Böttlinger contributes a new one of his own by evaporating repeatedly to dryness a mixture of aluminum sulphate and sodium chloride at 130° - 140° . This one analyses for $\text{Al}_2\text{O}_3\cdot\text{SO}_3\cdot 6\text{H}_2\text{O}$ or $\text{Al}_2\text{O H}\cdot\text{H}_2\text{SO}_4\cdot 2\text{H}_2\text{O}$ if we adopt Schlumberger's way of writing the formula.

ADSORPTION OF ALUMINUM SULPHATE BY WOOL.

Since the different salts of aluminum hydrolyze of themselves under suitable conditions, they should hydrolyze even more readily in presence of a textile fibre which adsorbs the alumina and they do as a matter of fact. In so far as the acid radical is also adsorbed, there may be minor complications and the matter may seem less simple than it really is.

When wool is treated with aluminum sulphate, $\text{Al}_2(\text{SO}_4)_3\cdot 18\text{H}_2\text{O}$, less than about five per cent. on the wool, the bath is exhausted completely, all the alumina and all the sulphuric acid being taken up.² With higher concentrations, more and more aluminum sulphate is left in the bath. There has been some discussion whether the wool takes up aluminum sulphate or alumina and sulphuric acid in the cases when the bath is exhausted completely. When wool mordanted in this way is boiled with water, the wash water is always acid, sulphuric acid being removed slowly and alumina left behind. This has been considered by von Georgievics³ as a proof that the sulphuric acid is free. While this may be true, it does not follow, because the adsorbed aluminum sulphate might be hydrolyzing. It is much wiser to admit frankly that we have no way at present of deciding this point. In case the acid is not combined in definite proportions, the next problem is whether it is adsorbed by the alumina, by the wool, or by the two in some unspecified ratio.

¹Underwood and Sullivan: "Printing Inks," 81 (1915).

²"The Manufacture of Lake Pigments from Artificial Colours," 51 (1900).

³Bull. Soc. chim. Paris, [3] 13, 41 (1895).

⁴"A Manual of Dyeing," 225 (1910).

¹Böttlinger: Liebig's Ann., 244, 224 (1888).

²Liechti and Schwitzer: Mitt. techn. Gewerbe-Museums in Wien, Sektion für Färberei, 3, 47 (1886).

³Chem. Centralblatt, 1895, 402; Binz and Rung: Zeit. angew. Chem., 1908, 628.

Ganswindt¹ gives some data by Fürstén-hagen and Appleyard² on the mordanting of wool by potash alum, which are reproduced and extended in Table I.

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TABLE I.

25.4% sulphuric acid in potash alum.

Potash alum referred to wool.	Sulphuric acid referred to potash alum.	
Concentration per cent.	Wool per cent.	Solution per cent.
5	25.4	0.0
10	22.1	3.3
15	14.6	10.8
20	11.0	14.4

Sulphuric acid referred to wool.

Wool per cent.	Solution per cent.
1.27	0.0
2.21	0.3
2.19	1.6
2.20	2.9

In the first column are the amounts of potash alum referred to the weight of wool. In the second and third columns are the percentages of sulphuric acid in the total amount of alum in the wool and the bath respectively. At 5% alum all the sulphate is taken up, but with higher concentrations of alum more of the sulphuric acid stays in the bath. Since determinations on the alumina adsorption are not given, we cannot tell to what extent alumina is adsorbed more than sulphuric acid. Since this method of presentation is not the usual one, I have added two columns to show the percentage of sulphuric acid referred to wool, taken up by the wool and left in the bath respectively. If these figures are to be trusted, the amount of sulphate adsorbed by the wool is practically constant when the bath contains 10%-20% alum referred to the wool. It is probable that this is not strictly true.

¹ "Theorie und Praxis der modernen Färberei," II., 83 (1902).

² Jour. Soc. Dyers and Colourists, 1888.

(To be Continued.)

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

The report described below has been published by His Majesty's Stationery Office for the Department of Scientific and Industrial Research. Copies, price 4s. (by post 4s. 3d.) may be obtained through any bookseller, or direct from H.M. Stationery Office at the following addresses:—

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FIRST REPORT OF THE ADHESIVES RESEARCH COMMITTEE.

This report embodies the results of certain of the investigations initiated by the Adhesives Committee of the Conjoint Board of Scientific Societies, and also the researches of a more fundamental character which have been undertaken by the Adhesives Research Committee of the Department of Scientific and Industrial Research. The report is thus a comprehensive summary of the work from its inception in 1918, up to the end of 1921.

The contents of the report are arranged under the following headings:—

- I. Introduction.
- II. Mechanical Tests of Adhesives for Timber.
- III. Casein Adhesives.
- IV. Gelatin Adhesives.
- V. Vegetable Adhesives.
- VI. Other Adhesives.

Appendix I. Descriptive Bibliography of Gelatin.

Appendix II. The Bearing of Results obtained in recent Investigations of Soap Systems upon the Structure of Gelatin Gels.

The first appendix is a comprehensive survey of the scientific literature of gelatin viewed from the physico-chemical standpoint.

The report is illustrated by diagrams and photographic plates.

NOTE ON DINITROBENZIL.

By E. DE BARRY BARNETT, B.Sc., F.I.C.,
AND L. J. KAY, B.Sc.

If the "bridge" bond formula for anthracene is correct, it should be possible to syn-

these anthracene derivatives from compounds in which two benzene rings are joined by a normal chain of two carbon atoms. The most readily obtained compounds of this class are the benzoin and benzils, and experiments have been carried out with the object of converting these into anthracene derivatives. So far no success has been attained, but during the course of the research it became desirable to prepare dinitrobenzil, and the object of this note is to point out that the preparation of this compound is very much more simple than would be gathered by a study of the literature.

The first description of the nitration of benzil is recorded in a paper by Zagumenny (*Journ. Russ. Chem. Soc.*, 1872, 4, 278), who boiled benzil with fuming nitric acid, and seems to have obtained a mixture of isomers. Shortly afterwards Poirrier and Rosenthal (*D.R.P.* 44269) claimed that dinitrobenzil is obtained when benzoin is boiled with fuming nitric acid, but no details of the preparation are given in the patent. More recently Klinger and Martinoff (*Annalen*, 1912, 389, 234) have studied the nitration of benzil. Although they state that the nitration can be effected with a mixture of nitric and sulphuric acids, they recommend the use of water-white absolute nitric acid ($D=1.53$) at 2° . The preparation of such an acid is troublesome and is totally unnecessary, as it has now been found that the nitration of benzil takes place extremely smoothly when effected by a mixture of nitric and sulphuric acids. The resulting 3:3'-dinitrobenzil is obtained in almost theoretical yield and in a very pure state. The following are the details of the nitration:—Benzil (16 grams) is dissolved or suspended in 80 cc. of concentrated sulphuric acid and 16 grams of finely powdered potassium nitrate added in small amounts during half an hour. The whole is then allowed to stand over night, and the resulting thick yellow paste poured slowly into a large volume of cold water. The precipitate is collected, washed free from acid, and recrystallised from boiling alcohol. The resulting yellow needles are quite pure, and melt sharply at 109° .

As no derivatives of dinitrobenzil seem to have been prepared, it was thought advisable to prepare and analyse the phenylhydrazone. In spite of the two carbonyl groups dinitrobenzil only forms a mono-

phenylhydrazone under ordinary conditions. This was obtained when 3 grams of dinitrobenzil were dissolved in 100 cc. of warm alcohol and a solution of 2 grams of phenylhydrazine in a little 50 per cent. acetic acid added, and the whole boiled under reflux for an hour. On cooling, the mono-phenylhydrazone separated out and was purified by recrystallisation from glacial acetic acid. It melts with decomposition at 159° . (Found: $N=14.41$ C $H_{13}O_5N_4$ requires $N=14.40$ per cent.).

Several attempts were made to convert the dinitro-compound into a tetra-nitro-compound by further nitration, but the dinitro-compound was always recovered unchanged. This was even the case when a nitrating acid containing 20 per cent. of free sulphur trioxide was employed.

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E.C.3*

GENERAL NOTES.

ROYAL SCHOOL OF MINES FRECHEVILLE RESEARCH FELLOWSHIPS.

The Imperial College of Science and Technology, South Kensington, London, S.W.7, with which the Royal School of Mines is incorporated, is offering two Research Fellowships of £300 a year each, tenable for one year and possibly renewable for a second year, to aid in carrying out any investigation or research connected with Mining, Mining Geology, Metallurgy, or the Technology of Oil, which in the opinion of the Selection Committee is of sufficient use or promise.

Applicants, who may be Associates of the Royal School of Mines or others, and preferably men with some practical experience, should apply in writing to the Secretary of the College (from whom further particulars may be obtained) before 1st September, 1922, giving the nature of the proposed investigation, qualifications for the work and references.

It is anticipated that the Committee will make the awards by the end of November, so that the Fellowships and work may begin on 1st January, 1923. Holders will be expected to devote their whole time to the work, which may be conducted at the Imperial College, or in special circumstances elsewhere at the discretion of the Committee.

THE BOARD OF TRADE.

SAFEGUARDING OF INDUSTRIES ACT.

Part I.: Arbitrations under Section 1 (5).

Judgment has been given by the Referee in the matter of a complaint under the above Sub-Section that R. Sodium Hypsulphite (otherwise Sodium Thiosulphate) has been improperly included in the lists of articles chargeable with duty under Part I. of the Act. The Referee has awarded that the grade of this chemical covered by the term R. Sodium Hypsulphite is properly included amongst the articles liable to duty and that the complaint therefore fails. The Referee, however, directs that, for the sake of clearness, as the grade so covered is commonly known as "photographic quality," the words "photographic quality" should be inserted in the lists after the words "Sodium Hypsulphite." As from the date hereof the lists will accordingly be amended as follows:—

For "R. Sodium Hypsulphite" read "Sodium Hypsulphite (photographic quality)."

For "R. Sodium Thiosulphate" read "Sodium Thiosulphate (photographic quality)."

QUALITATIVE TEST FOR URANIUM.

H. D. BUELL.

A solution of the ore or slag to be tested is made in nitric acid, a large excess of which is not needed. Granulated zinc is then added, when in the presence of uranium a yellow deposit on the zinc will be formed. Using uranium nitrate, 0.88 mg. per cc. of solution could be detected by this means. HCl or H_2SO_4 should not be present, as in such cases a black deposit is produced. Iron and vanadium must not be present in large quantities, but the test is not interfered with by gold, platinum, thorium, lead, tungsten, titanium, mercury, chromium, or copper.—(*J. Ind. Eng. Chem.*, 1922, p. 593.)

SYNTHESIS OF UREA.

An investigation into the large scale production of urea from ammonia and carbon dioxide has been undertaken by Krase and Gaddy (*J. Ind. Eng. Chem.*, 1922, p. 611). The first step of the process is the preparation of ammonium carbonate from ammonia and CO_2 , and in this direction the use of liquid ammonia was not found satisfactory. It was ascertained that for the present purpose, the condensation of the requisite amounts of ammonia gas, carbon dioxide and water vapour gave good results, and the condenser was fitted with a rotating blade by which the ammonium carbamate was continually removed. Not more than 1.5 per cent. water should be present in the carbamate, otherwise it has an adverse effect on the yield of urea. The ammonium carbamate is now made into briquettes, which are introduced into an autoclave and heated to 150°C ., when conversion into urea takes place. The so-called sludge from the autoclave has next to be distilled in a current of CO_2 in order to remove unchanged ammonia. On a large scale arrangements are such that the process is practically continuous.

OXIDATION OF POTASSIUM ACETATE TO POTASSIUM OXALATE.

W. L. LLOYD AND P. R. HINES.

The authors find that potassium acetate can be oxidised with alkaline permanganate to potassium oxalate. This is contrary to the findings of Denis (*Am. Chem. Jour.*, 1907, p. 568), but such differences are found due to conditions at the time of the experiment, time, concentration and temperature having a bearing on the reaction.

NOTE.

Referring to a letter by John Missenden, published in our issue of July 7th, dealing with research, we have received a further communication from the same source, giving the name of H. P. Sholl, of 1, Maxted Park, Harrow, who is prepared to undertake research work in the field of Organic Chemistry.

INDUCED REACTIONS AND MECHANISM OF CHEMICAL CHANGE.

By D. R. DHAR.*

[In a foregoing paper (*Trans. Faraday Soc.*, 1921; *Chemical News*, December 16, 1921) it has been proved that the phenomenon of induced oxidation is of general occurrence.

In this paper several other induced reactions have been investigated. A very brief outline of recent work on the mechanism of Chemical Changes has also been given.]

* A part of the Presidential Address at the Chemistry Section of the Indian Science Congress, 1922.

Oxidation has now been induced in the following substances in presence of sodium sulphite which was itself oxidised by passing oxygen gas through the mixtures:—

Urea, starch, grape sugar, cane sugar, potassium oxalate, sodium acetate, sodium potassium tartrate, sodium formate, sodium citrate, acetone, chloral hydrate, chloroform, glycerol, quinine sulphate, sodium succinate, methyl alcohol, phenol, glutaric acid, maltose, potassium stearate, cholesterol, anthraquinone, acetanilide, brucine, phenolphthalein, and gum arabic.

The oxidation of ferrous hydroxide, freshly precipitated and carefully washed free from alkali, by passing oxygen through it in water induces the oxidation of the following substances:—

Urea, starch, grape sugar, cane sugar, potassium oxalate, sodium acetate, sodium potassium tartrate, sodium formate, sodium citrate, acetone, chloral hydrate, glycerol, quinine sulphate, sodium benzoate, sodium succinate, methyl alcohol, phenol, phenolphthalein, and gum arabic.

In the following cases of oxidation, either in presence of sodium sulphite or freshly precipitated ferrous hydroxide along with carbon dioxide, the presence of aldehyde (which is an intermediate product of oxidation) was detected by Schiff's reagent:—

Methyl alcohol, ethyl alcohol, amyl alcohol, glycerol, glutaric acid, phenol, and brucine.

In the case of oxidation of benzyl alcohol, acid test was obtained with litmus.

The wide application and the general usefulness of these induced reactions are evident from the fact that these various com-

pounds which do not undergo oxidation by oxygen under ordinary conditions can be readily oxidised when they are mixed with sodium sulphite or ferrous hydroxide, which is itself being oxidised.

It is evident that there will be different stages of oxidation of these organic compounds until the final products of oxidation are obtained.

RELATION TO LIFE PROCESSES.

It is impossible to ignore the importance of these reactions in their relation to the phenomena of oxidation and reduction in the animal body. It is well known that a molecule of stearic acid taken into the body in the form of fat undergoes combustion, so that eventually each of its eighteen carbon atoms will be converted into carbon dioxide, but no one imagines that such a change is immediate or direct—that every carbon atom simultaneously parts with its attached hydrogen atoms, and by combining with oxygen yields carbon dioxide and water. We have brought about the same change in the laboratory with potassium stearate by inducing its oxidation by the primary oxidation of sodium sulphite or ferrous hydroxide by passing oxygen through the mixture at the ordinary temperature.

In the animal body, acetic acid is oxidised with great ease to carbon dioxide and water. Its oxidation in the laboratory has been effected by us with the help of sodium-sulphite or ferrous hydroxide when it is being oxidised by passing oxygen through it.

The substance undergoing active metabolism in the animal body, comprising the proteins, carbohydrates, fats and their derivatives, are practically entirely resistant to oxidation by oxygen under ordinary conditions, yet in the animal body the carbon of all these types of compounds is readily oxidised to carbon dioxide. It is generally conceded that some process of activation of the atmospheric oxygen must take place in the body in order to account for the observed chemical changes. It is remarkable that a very large number of such biochemical oxidations have been imitated in the laboratory by the simple process of induced oxidation as already mentioned. We are now engaged in further generalising this type of induced oxidation and in finding out the intermediate products of oxidation in these cases.

It has been shown in a previous paper that the oxidising power of hydrogen peroxide is greatly accelerated in presence of ferrous and ferric salts; thus, if tartaric

acid or starch and hydrogen peroxide be brought together at the ordinary temperature hardly any chemical reaction takes place, but as soon as a ferrous or a ferric or starch rapidly takes place (*Dhar., Jour. Chem. Soc.*, 1917, III., 694). There is a great importance of reactions of this type in the explanation of oxidations in the human body. The food in the animal body is oxidised by the atmospheric oxygen giving us heat and energy. In the animal body there is evidence with regard to the formation of a peroxide from the oxygen taken up by the animal and this peroxide oxidises the food taken up in the body.

EXPLANATION OF THE USE OF IRON SALTS IN MEDICINE.

As we have shown in the laboratory, that iron salts (either ferrous or ferric) markedly accelerate the oxidising power of the peroxide, similarly in the animal body the iron in hæmoglobin present in the blood catalytically accelerates the oxidation of the food stuff by the peroxide formed in the body from the inhaled oxygen. Now when there is deficiency of iron in the blood, the animal body suffers from anemia because the amount of catalyst necessary for rapid oxidation falls short. At this stage any iron salt taken in the system will supply the natural deficiency, and the necessary amount of oxidation will take place. This is the probable mechanism of the internal use of iron salts, whether ferrous or ferric, in medicine. It has also been observed that induced oxidation can take place in the acetic fermentation of alcohol.

INDUCED PRECIPITATION.

The phenomenon of induced precipitation is of common occurrence. When any one of the phosphates of iron, aluminium, or chromium is precipitated by sodium phosphate in presence of acetic acid and calcium chloride, the precipitate after being thoroughly washed with acetic acid, gives test for calcium with ammonium oxalate.

Similarly strontium or barium phosphate is precipitated along with ferric phosphate or aluminium phosphate or chromium phosphate, even in presence of acetic acid.

When any of the hydroxides of iron, aluminium or chromium is precipitated in an excess of concentrated ammonium hydroxide in presence of copper sulphate, zinc sulphate, nickel chloride or cadmium nitrate, the precipitates, even after being thoroughly washed with concentrated am-

monia gives test for the ions in presence of which the precipitation has been carried out.

When calcium, strontium or barium carbonate is precipitated by means of ammonium carbonate from any of their soluble salts containing a little of magnesium chloride, the precipitate after being thoroughly washed with ammonium chloride shows the presence of magnesium.

Moreover, when a little of sulphuric acid is added to a solution of calcium or strontium, or barium chloride containing ferric or chromium or aluminium salt, the precipitated sulphates of calcium, strontium or barium contain iron, or aluminium or chromium. Similarly lead sulphate is precipitated along with barium sulphate, even in presence of a large excess of ammonium acetate.

Magnesium oxalate is precipitated with barium or strontium or calcium oxalate, in presence of an excess of ammonium chloride and ammonia.

These facts make it clear that the phenomenon of induced precipitation is of very general occurrence.

COPPER AND NITRIC ACID.

The action of copper on 20 per cent. nitric acid, though slow at the ordinary temperature, can be accelerated by the inductor nitrous acid. If two pieces of copper wire are put into two test tubes containing the same amount of 20 per cent. nitric acid and one of the tubes kept at rest, whilst the other is vigorously shaken, it will be found that, contrary to our ordinary experience, the copper in the tube at rest will dissolve much more quickly, because the inductor nitrous acid formed by the action of copper on nitric acid remains in contact with the copper in the tube at rest, whilst in the other case, the inductor is diluted throughout the whole mass of nitric acid.

On investigating these various cases of induced reactions, we were naturally led to the more general conclusion that one chemical change should induce another chemical change of the same type, and we tried to verify this conclusion. We found that the reduction of mercuric chloride by such different reducing agents as formic acid, sulphurous acid, phosphorous acid, etc., induce in all cases the reduction of the same substance, e.g., mercuric chloride, by sodium arsenite. We also investi-

gated other changes, as for instance, the decomposition of unstable substances.

POTASSIUM CHLORATE DECOMPOSES MORE READILY IN PRESENCE OF DECOMPOSING AMMONIUM BICHLORATE OR POTASSIUM PERSULPHATE.

It is well known that ammonium dichromate decomposes readily into nitrogen, water and chromium oxide, also the decomposition temperature of potassium persulphate is lower than that of potassium chlorate, and it has been found that in presence of decomposing ammonium dichromate or potassium persulphate, the decomposition temperature of potassium chlorate is appreciably lowered. In this connection it will be of interest to investigate whether the presence of an easily decomposable explosive will lower down the decomposition temperature of a difficultly decomposable explosive, and this investigation will throw light on the velocity of decomposition of mixed explosives.

ONE CHEMICAL CHANGE WILL EITHER PROMOTE OR INDUCE ANOTHER CHANGE OF THE SAME NATURE.

Farmer (*Jour. Chem. Soc.*, 1920, 117, 1603, 1432) has recently shown that the velocity of decomposition of high explosives becomes greater in presence of another explosive which is more readily decomposed. As far as our experiments go, we are inclined to the view that one chemical change will either promote or induce another chemical change of the same nature.

MECHANISM OF CHEMICAL CHANGE.

Being occupied so far with the question of acceleration and retardation of the velocity of chemical reactions, it would not be out of place to say a few words about the velocity itself. Within the last few years, a great deal of theoretical work in this direction has been done, notably by Perrin and Lewis. In a recent article (*Ann. Phys.*, 1919 (9) 11, 5) Perrin shows that Arrhenius' equation for reaction velocity and temperature can be derived from the Planck or Wien radiation law on the assumption that the chemical action depends on the absorption of a nearly monochromatic radiation.

RADIATION IS THE MOTIF OF ALL CHEMICAL CHANGES.

In other words, these investigators postulate that radiation is the entire *Motif* of all chemical reactions, as well as of radioactivity and changes of state.

From our experimental work (*Proc. K. Akad. Wetensk. Amster.*, 1920, 23, 308) it has been shown that radiation is an essential factor in a chemical change, although the hypothesis of Perrin is still of a qualitative nature. Recently, Langmuir criticised adversely this hypothesis. Simultaneously with Langmuir, Lindemann published a paper (*Phil. Mag.*, Nov., 1920), in which he proved that according to Lewis' radiation hypothesis of the velocity of chemical reactions, the rate of cane sugar inversion in the presence of hydrochloric acid should be about 10-13 times greater in sunlight than in the dark. He adds, "yet the reaction proceeds at appreciably the same rate whether exposed to sunlight or not." Our experiments do not corroborate the above conclusion. We have found that a solution of cane sugar can be completely converted into a mixture of invert sugars at the ordinary temperature by exposing it to tropical sunlight, even in absence of acids, and the inversion of cane sugar in the presence of hydrochloric acid is markedly accelerated by sunlight (compare Dhar, *Zeit. Anorg. Chem.*, 1921).

It should now be emphasised that there is no fundamental difference between the mechanism of photochemical and thermal reactions. In a photochemical reaction the radiating body is not in thermal equilibrium with the reacting substance as it is in a thermal reaction, and the distribution of energy amongst the different frequencies does not necessarily follow Planck's distribution law.

From the foregoing pages, it is clear that there are a lot of theoretical and experimental evidence, more of a qualitative nature than quantitative, in support of the radiation hypothesis which seeks to establish a connection between chemical changes (thermal, photochemical and catalytic) and radiation. Hence, instead of discarding the radiation hypothesis we should try to bring fresh evidence, both theoretical and experimental, in support of the hypothesis, and try to make it more quantitative.

Chemical Laboratory,

Muir Central College,

Allahabad, India.

NOTICES OF BOOKS.

Dyes Classified by Intermediates, by R. NORRIS SHOEVE. New York: The Chemical Catalog Co., Inc., 1922. Price \$10.00 net.

This work aims at showing the relative importance of the various intermediates used in the manufacture of synthetic dyestuffs. The plan adopted has been to arrange the intermediates in alphabetical order, then to give some information about them, such as the methods of formation, references to the literature, and statistics to indicate their importance in the United States of America, and, finally, to give similar information (in the form of tables) relating to the various dyes derived from them.

The majority of the more important intermediates have been included, but the omission of such important alkylating agents, as dimethyl sulphate and ethyl chloride, has been noticed. A good point has been made by drawing attention to the advantage of using the empirical formula for reference purposes, and to enable this method to be employed, a very useful "Formula Index of Intermediates" has been given near the end of the volume. The synonymous names of the intermediates have been included in the alphabetical arrangement.

The short description of the "methods of formation" of the intermediates aims at giving the usual commercial method of preparation. Unfortunately, the method given is not always the correct one. This applies to that given for the preparation of benzene and toluene sulphonyl chlorides, where one would expect to find the chlor sulphonic acid method given instead of that using phosphorus pentachloride.

The references to the literature are poor, and as a rule simply refer one to some standard work on the subject, such as J. C. Cain's "Manufacture of Intermediate products for Dyes," or Lange's "Die Zwischenprodukte der Teerfarbenfabrikation," where one would naturally expect to find the subject mentioned without the author's direction.

The several different names which have been given to the same dyestuff by the various manufacturers, render the selection of a representative name a difficult matter. However, having made a choice, it would be reasonable to expect the name chosen to do duty throughout the book, but the

author selects the names "Magenta" and "Fuchsine" and then refers to the same dyestuff as "Rosaniline" when dealing with the soluble blues, and omits the name Rosaniline from his "Glossary of Dye Names" altogether.

The weakest point of the whole work, and, unfortunately, it is the one which ought to be the strongest if the book is to serve the purpose for which it was written, is in connection with the statistical data. As every dye chemist knows, it is often possible to obtain the same dye by more than one synthetical process (involving the use of different intermediates), and, as a rule, one is a commercial method, whilst the others are of purely academic interest, yet the author gives the same statistics under the intermediates not used as under those that actually are, without any indication that he is conscious of the fact.

The work as a whole is disappointing, but as it is the first attempt to treat the subject from this viewpoint, it is to be hoped that another attempt on similar lines will be made in the near future.

Chemistry for Beginners and Schools, by C. T. KINGZETT, F.I.C., F.C.S. Fourth edition; pp. V.I. + 237. London: Baillière, Tindall & Cox, 8, Henrietta St., Covent Garden, 1922. Price 5s. net.

Mr. Kingzett rightly points out that our future commercial prosperity depends upon our greater cultivation of science. Every boy should have an opportunity to acquire an elementary knowledge of chemistry and physics.

This little book is intended for the use of beginners, especially boys.

Whilst much of the matter is very good, the book is rather too full of facts for beginners. Thus, Part III. is largely an alphabetical catalogue of the elements (including rare earth and noble metals) and their chief compounds.

Chemical apparatus and the details of experiments are dealt with separately (Part IV.), also alphabetically. Finally, the extensive glossary (Part V.) serves also as an index.

The most important alteration in this edition is the enlargement of the glossary.

That the book has so quickly reached a fourth edition is sufficient to indicate its popularity.

J. G. F. D.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs can be obtained gratuitously.

Latest Patent Applications.

- 18758—Freeth, F. A. Production of ammonium chloride and sodium carbonate. July 8.
 18460—Guggenheim Bros. Leaching caliche and recovery of nitrate therefrom. July 5.
 18712—Petroff, G.—Production of phenol formaldehyde condensation products. July 7.
 18713—Petroff, G.—Production of phenol aldehyde condensation products. July 7.
 18804—Scottish Dyes, Ltd.—Manufacture of dye-stuff intermediates. July 8.

Specifications Published This Week.

- 155592—Nitrogen Corporation. — Synthesis of ammonia.
 181775—Dutt, E. E., and Dutt, P. C.—Process for the preparation of titanium dioxide from bauxite.
 181835—Bloxam, A. G.—Manufacture of liquid esters of phosphoric acid.
 181837—Pearson, R. E., Craig, E. N., and Durelco, Ltd.—Reduction of oxides of tungsten and molybdenum.
 181884—Ebbw Vale Steel, Iron and Coal Co., Ltd., and Thickins, D.—Manufacture of dry neutral sulphate of ammonia.
 163323—Nitrogen Corporation.—Preparation of hydrogen and ammonia.

Abstract Published This Week.

179982—Sodium ferrocyanide—Delaroziers, F. F., 22, Avenue Jean Jaures, Gentilly, Seine, France.

Sodium ferrocyanide is produced by adding sodium sulphate to a solution of calcium ferrocyanide and separating the calcium sulphate. Alternatively insufficient sodium sulphate may be employed to react with all the calcium, and, after separation of the calcium sulphate, the remainder of the calcium may be precipitated by the requisite quantity or slight excess of sodium carbonate. Crude salt-cake containing some sodium chloride may be employed, or sodium chloride be added to cause a greater separation of sodium ferrocyanide.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

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THE SESSION 1922-23 COMMENCES
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THE CHEMICAL NEWS,

VOL. CXXV., No. 3252

Shall German Brains Beat British?

By LORD BIRKENHEAD,

LORD HIGH CHANCELLOR OF GREAT BRITAIN.

It has been said, with more point than politeness, that statistics never lie unless the statistician is a liar. I want to begin, notwithstanding this forbidding epigram, with some statistics which tell their own tale so plainly that no one can misunderstand or misuse them. I am not responsible for the figures, for I take them from official Blue-books.

To begin with, here are the values of the chemicals imported into this country during the years 1913-1919:—

Years.	£
1913	4,534,536
1914	4,180,400
1915	7,493,134
1916	12,268,439
1917	14,178,139
1918	25,623,731
1919	7,248,780

Side by side with the above statistical story of our country's need for chemicals during the great war, another and very different story remains to be told, also in statistics. The following table gives the annual value of the exports of chemicals from Germany in the period preceding the war:—

Years.	£
1901	20,418,300
1902	21,520,500
1903	22,412,200
1904	23,674,900
1905	27,117,000
1906	29,510,200
1907	29,422,500
1908	27,702,800
1909	31,226,300
1910	35,551,000
1911	38,573,500
1912	41,923,500

The contrast is very striking. These statistics show us that in the period preceding the war Germany was making giant strides in the chemical industry. They are the statistical reflection of the fact, known to everyone, that in this industry she was the first and the rest of the world nowhere.

OUR HANDICAP.

Now, there are some people who can derive comfort from the pious faith that the pre-war position of the chemical industries is an excellent illustration of the great advantages that flow from what they call the "international division of labour."

Nature, they say, marks out certain territorial areas as suited for one industry and not suited at all, or much less suited, for another. They go on to argue that what Nature does in extreme cases man rightly proceeds to do in other cases not so extreme. Man places the chief seat of the heavy chemical trades in the United Kingdom and the chief seat of the fine chemical trades in Germany. It works out for the advantage of everybody. We specialise in one thing and the Germans in another; and so we mutually supplement and round off our activities to the great advantage not only of ourselves but of the whole world. I agree, with a limitation. This harmonious theory of the territorial division of labour between one race of men and another supposes that men do nothing but work and trade. Unfortunately, they sometimes fight. They began to fight on August 1, 1914, and before many months had gone by it was discovered that the territorial division of the chemical industries between ourselves and Germany, even if it had been an advantage to us during peace, had at once become a definite disadvantage on the outbreak of war.

The plain truth is that it might have led to our defeat but for the fact that we set to work to draw raw materials from all parts of the world, and to manufacture for ourselves the essential chemicals of war of which Germany had had a practical monopoly.

Every man with a single grain of common sense fervently hopes that the great war taught the world that there should be no more war. But it is one thing to hate war and to hope that there will be no more war, and quite another thing to act on the supposition that there will be one. Hate and loathe war as he may, the patriot

statesman has got to reckon with the fact that the past history of the world is full of wars, and that whatever his hopes may be, he must act on the supposition that war has not come to an end.

And, judging from the history of the last war, those who have the right because they have the knowledge, to demand that we should listen to them, tell us without hesitation that chemistry will play a greater part in the next war than it did in the last. It is not merely a question of poison gas, the use of which the Germans introduced, to their subsequent great regret. Chemistry is closely concerned with the manufacture of those instruments of war, the use of which is perfectly legitimate. The best gun and the best explosive will fall in the long run to the nation with the best chemicals.

THEIR ADVANTAGE.

During the war we improvised a fine chemical industry, which enabled us to carry on and pull through. But, naturally enough, the reopening of trade between Germany and the rest of the world, including ourselves, brings us face to face with this question: How are we to make sure that in the matter of chemicals no subsequent experience, whatever it be, shall find us once again, as in August, 1914, at a complete disadvantage in relation to Germany? For, so far as these trades are concerned, Germany begins the peace with almost the same superabundance of advantages with which she began the war. If, on the one hand, the workers in her chemical trades are now slovenly and slack in comparison with pre-war days, the exigencies of war drove German chemists to make discoveries of very great importance.

I have no technical knowledge on these points, but I read, for example, that she successfully made synthetic rubber, and that she was also successful in turning her lignite, or brown coal as it is commonly called, into oil; and it requires no technical knowledge to be able to argue that if she succeeds by further effort in doing these things on a commercial scale and on commercial terms, she has worked two miracles which will give her a tremendous advantage in the industries of peace.

We cannot rob them of these advantages, and we do not propose to try. What we must do is to follow suit.

At bottom the question is: Shall German brains beat British brains? And here

I want to point a very obvious moral. Not only do our extremists constantly talk as if, from the economic point of view, the only kind of labour that counted was manual labour, but our Labour leaders, who surely know better, disparage all the higher sorts of labour, inventive and directive, by constantly ignoring them on the platform—a considered piece of propaganda for which the cautious praise of Mr. Sidney Webb, in his innumerable and unending books, pamphlets, leaflets, and memoranda, is no real counterpoise. The most important kind of labour in this or any other country is brain labour.

I am at a disadvantage in one respect because Germany has never been, and never, I imagine, will be, my spiritual home. The deficiency, however, does not prevent me from discerning a very important difference between the two brains, German and British. It was a British chemist, Perkin, who discovered that dyes could be made from coal tar. It was German chemists who made them and refined on them in such a way that the British textile trades became absolutely dependent on German dyes.

The British brain works best upon special lines of its own. Think of two men, quite unknown to each other, Darwin and Wallace, simultaneously working out the great doctrine of evolution. In a word, the individualism which is the root characteristic of the Englishman, applies not only to his conduct and to his creed, but affects the whole of his mental processes. I profoundly believe that in the war that was a great advantage. The self-reliance of Englishmen, their capacity to think, reason, and act for themselves were of untold advantage in the trenches.

But note another thing. At home, in order to win the war, we had to imitate the Germans in one important respect. *We had to do our brain work in teams.* Our scientists had to do their researching as an organised body. Someone had to dictate the ends to be sought and to suggest the methods to be adopted. We won the war by pooling not only our energy but our minds.

Now, this is precisely how the German chemists built up their giant industry. In June, 1919, the Association of British Chemical Manufacturers sent a highly qualified mission into the occupied territories of Germany to examine things on the spot. It is clear that the mission came

back deeply impressed by what they had seen.

TRAINING FOR THE FUTURE.

They had made up their minds that German success in the chemical industry was thoroughly deserved because it had been won by honest labour. Whose labour? The great organisers of industry—the men who stand at the head of such gigantic firms as Bayer and Company and Lucius and Bruening deserve their full share of praise. Probably when they banded themselves into the "I.G."—a combine of all the great firms—they may have lost in initiative what they gained in efficiency. That is a matter on which no one can dogmaise. But at bottom the labour which built up the German chemical industry was the labour of chemists.

In Germany the trained chemist has come to occupy a position in society strictly analogous to that occupied in this country by the lawyer or the clergyman. Chemistry in Germany is a liberal profession, and chemists of the highest quality abound.

Though I have been writing throughout of one industry only, it is obvious enough that I have had industry as a whole in view. The manufacturers of this country have got to make up their minds on one point. They must either train and use brains plentifully and bountifully, or fall behind in the race for industrial success.

The workshop and the university must be linked together. The laboratory and the library are as essential elements of business success as the costing department and the counting house. The twins of trade henceforth are the great organiser and the great scientist.

[Reprinted by courtesy of the "Weekly Dispatch."]

THE DETERMINATION OF CULTURED PEARLS.

By Cyril S. Fox.

In the author's paper, "Notes on Indian Precious Stones," published in August, 1921, in the *Journal of Indian Industries and Labour*, Vol. 1, Part 3, p. 325, the question of "cultured" pearls was dealt with in a general sort of way. It was there assumed that the nucleus of the cultured pearl was of exceedingly minute dimensions, and attention was called to the fact that experienced pearl merchants and certain

zoologists could distinguish, by little differences of colour and sheen, pearls from various countries, e.g., Japan, Australia, Ceylon, etc., but that when it came to a question of distinguishing natural pearls from cultured pearls of the same locality¹ there was no present method, other than by cutting the pearl in half, of telling the one from the other. Subsequent tests by prominent pearl dealers and others have only confirmed the above statement in respect of *Japanese* natural and cultured pearls.

Dr. Herbert Smith, of the Natural History Museum, London, working in collaboration with Messrs. E. Hopkins,² of St. Andrew's House, 32/34, Holborn Viaduct, who supplied the material for experiment and made valuable suggestions, has examined many varieties of pearls in ultra violet light (as developed by the electric arc and mercury vapour lamp of the type in use by many jewellers dealing in pearls).

These workers find that practically all pearls from the Persian Gulf, generally known as Indian (and which comprise 90 per cent. of the pearls from the East), can be distinguished immediately from Japanese pearls, both natural and cultured, and from certain pearls from Australian waters.

The differences which the writer saw, in the specimens shown to him, between natural pearls and the trade Japanese cultured pearls, when examined in ultra violet light, were obvious. The natural pearl, though fluorescent, is opaque in ultra violet light, whereas the Japanese type of pearl has a distinct translucent opalescence, and it does not require the services of an expert to see the difference.

A number of facts have been collected during recent investigations to show that the substance of the mother-of-pearl and pearl of the Japanese oyster is in a slightly different condition to that forming the shells and pearls of oysters from Indian (Persian Gulf) localities. Thin sections of the mother-of-pearl of the Australian oyster and Japanese pearls show the lamination and concentric growth very delicately

1 So far as is known, pearls are only being cultured in Japan.

2 This progressive firm has now established a small mercury vapour lamp in its offices, and can carry out tests in a few minutes.

Distance in c.m.	Refractive index.	Distance.	Index.
20	1.000	41	1.512
21	1.047	42	1.5238
22	1.09	43	1.534
23	1.13	44	1.5454
24	1.16	45	1.5555
25	1.2	46	1.565
26	1.23	47	1.5745
27	1.26	48	1.583
28	1.285	49	1.5918
29	1.31	50	1.6
30	1.333	51	1.607

The temperature of the liquid can be adjusted by placing the glass plate and lens into water of the temperature required for a few minutes before use. One drop of the liquid, or at most two, is required for the reading. It is better to start with the platform at the top and gradually lower it. The apparatus can easily be extemporised, and the calculation required is reduced to a minimum.

ALUMINA.

HYDROLYSIS OF ALUMINUM SALTS.

By Wilder D. Bancroft.

(From the *Journal of Physical Chemistry*,
June, 1922.)

(Continued from Page 57.)

Knecht¹ comments on these data as follows: "It is a prevalent opinion that when wool is boiled with aluminum sulphate, for instance, the salt is decomposed by the fibre in such a manner that aluminium hydrate and sulphuric acid are formed, of which the former is assimilated by the fibre, while the latter remains in solution. Others again assume that an insoluble basic sulphate of alumina is formed on or in the fibre. Quantitative determinations, carried out by Fürstenhagen and Appleyard, show that when wool is boiled with a solution of alum no free acid remains in solution when the amount of alum does not exceed five per cent. of the weight of the wool. When larger amounts are used, a basic sulphate of alumina is fixed on the fibre. Now it has always been shown that wool possesses a considerable affinity for both acids and bases, and, in its whole behaviour it evidences the properties of an amido acid—that is a substance possessing

simultaneously basic and acid properties. This would explain in a satisfactory manner the fixation of both the acid and basic constituents of the alum, but in what form these are fixed still remains a matter of conjecture. It is not improbable that the phenomenon is due to actual chemical combination with the fibre or with certain constituents of the latter; just as lead or mercury, when absorbed by the system, enters into chemical combination with the albuminoids in the various organs. That a hydrate is not formed is conclusively shown in mordanting wool with copper salts. The fibre assumes a green colour; but copper oxide, when boiled, is at once dehydrated and transformed into black copper oxide. If copper hydrate had been formed, the fibre would be black, whereas it is green, and remains so even after prolonged boiling."

It has already been shown that Fürstenhagen and Appleyard have not proved by quantitative determinations that a basic sulphate of alumina is fixed on the fibre. They have proved that both alumina and sulphuric acid are taken up by the fibre; but nothing more. Knecht seems to realise this unconsciously, because he himself admits that it remains a matter of conjecture in what form the acid and basic constituents of the alum are fixed. That is true; but that is quite a different thing from showing that a basic aluminum sulphate is fixed on the fibre. Knecht's argument in regard to the copper hydrate is fallacious because hydrous copper oxide does not necessarily turn black when heated to 100°. Tommasi¹ showed that when a little hydrous manganous oxide is precipitated with the hydrous copper oxide, the latter does not turn black when boiled. Blucher and Farnau² found that a similar stabilisation of the blue colour could be obtained by adding hydrous oxides of nickel, cobalt, aluminium, chromium, and magnesium. With zinc there was some stabilisation, but practically none with mercury. If the blue colour is due to the state of sub-division of the copper oxide, anything which will prevent it from agglomerating will keep it

1 *Bull. Soc. chim. Paris*, [2] 37, 197 (1882); *Comptes rendus*, 99, 37 (1884).

2 *Jour. Phys. Chem.*, 18, 629 (1914).

1 Knecht, Rawson and Loewenthal: "A Manual of Dyeing," 58 (1910).

blue. Schenck has shown that a mixture of the oxides of copper and alumina containing about five per cent. copper oxide can be heated in a blast lamp without turning black. Owing to the lower copper content the colour is a light greyish blue. With ten per cent. copper oxide, the blue colour was deeper and withstood heating in a Bunsen burner, but showed signs of turning black when heated in the blast lamp. During the winter of 1920-21 Mr. R. K. Parsell repeated Mr. Schenck's experiments and, after heating, dissolved out as much alumina with caustic soda as he could get without getting any blackening. In this way he was able to get a powder which was a beautiful deep blue and which contained approximately seventy-five per cent. cupric oxide and twenty-five per cent. alumina. If one insisted on writing a formula for this, it would be approximately $(\text{CuO})_1, \text{Al}_2\text{O}_3$, which is rather absurd. There are not only no indications of a definite chemical compound; but, after standing for a year the powder has changed from blue to green. We do not know whether it will go black in time or not.

According to Havrez² and to von Georgievics³ the amount of sulphuric acid taken up by wool from an aluminum sulphate or an alum bath increases relatively to the wool at high concentrations until at twenty-four per cent. alum referred to the wool, the alumina and the sulphuric acid are taken up in the same relative amounts as they occur in aluminum sulphate. At higher temperatures, relatively more sulphuric acid is taken up. I have never seen the original data and the abstracts are confusing and to some extent contradictory. Havrez⁴ claims that with high alum concentration, the peptizing action of the alum on the alumina is so great that less alum is taken up than at lower concentrations. If this is true, the amount of alumina adsorbed passes through a maximum. On the other hand he apparently based his conclusion on the fact that wool mordanted in concentrated alum solutions did not dye to so deep a shade and this may be an

effect of the sulphate taken up. Leichti and Hummel, however, "disagree with his assertion that an excess of alum acts like an acid which dissolves the alumina." Dreaper¹ who gets Havrez's name wrong, says that "Harvey pointed out in 1872 that in the case of very concentrated solutions of alum, more sulphuric acid than alumina is absorbed. This has been recently confirmed by von Georgievics. It appears that with a 24 per cent. solution of alum [referred to wool], and a proportion of water fibre of 30:1 alumina and sulphuric acid are taken up in their normal proportions. The affinity of wool for acid is stronger in dilute solutions and stronger for the alumina in strong solutions. The relative curves cross each other at 24 per cent." There must be a misprint in the next to last sentence of this quotation, the words acid and alumina being transposed.

Havrez² states, and Leichti and Hummel confirm him, that addition of acid (presumably sulphuric acid)³ is beneficial with such low concentrations of alum as one per cent. on the wool. Since all the alumina is taken up at these concentrations, the object of adding the acid cannot be to increase the adsorption. The statement is made that with low concentration of alum the bath becomes alkaline, in which case the acid is added to counteract this. It is not clear whether the alkalinity is due to lime in the wool reacting with sulphuric acid, to ammonia going out from the wool, or to a partial adsorption of sulphuric acid from the potassium sulphate of the alum. This last hypothesis could be tested by running similar experiments with aluminium sulphate. Leichti and Suida⁴ state that alum is not quite as good a mordant as aluminum sulphate, though the difference is not marked. This may seem to contradict their alleged previous statement that sodium sulphate increases the hydrolysis of aluminum sulphate on boiling; but the contradiction disappears if we postulate, which seems reasonable, that the sodium sulphate, though increasing the hydrolysis of the aluminum sulphate, also increases the relative amount of sulphuric acid taken up by the

1 *Ibid.*, 23, 283 (1917).

2 *Chem. Centralbl.*, 1874, 696; Cf. Leichti and Hummel; *Jour. Soc. Chem. Ind.*, 13, 226.

3 *Jour. Soc. Chem. Ind.*, 14, 653 (1895).

4 *Jour. Chem. Soc.*, 26, 206 (1873).

1 "The Chemistry and Physics of Dyeing," 62 (1906).

2 *Jour. Soc. Chem. Ind.*, 13, 226 (1894).

3 Cf. Knecht, Rawson and Loewenthal; "A Manual of Dyeing," 237 (1910).

4 *Jour. Soc. Chem. Ind.*, 5, 526 (1886).

wool. The first would be beneficial and the second harmful, and we do not know to what extent the two balance, or even whether this is the true explanation.

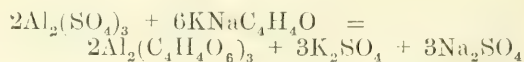
One objection to alum or aluminum sulphate as a mordant is that the sulphate coagulates the hydrolyzed salt so readily that very perceptible amounts of alumina or of basic salt are precipitated in the bath or on the wool in such a form that it rubs off. It seems as though this could be got round by heating the solutions more slowly. A simpler method of getting round this difficulty is to use aluminum salts of organic acids, which hydrolyze more readily than the sulphate because the acids are weaker, and yet which keep the colloidal alumina peptized in a finer form.

ADSORPTION OF ALUMINUM TARTRATE. ETC., BY WOOL.

This was done more than a century ago by adding tartar (acid potassium tartrate) to a solution of alum.¹ "To impregnate wool or woollen cloth with the aluminous basis, it is commonly boiled in water, with from one-fourth to one-sixth of its weight of alum, and from one twelfth to one-sixteenth of its weight of crude tartar, putting the latter first into the water, and, afterwards, the powdered alum: the heat of the water being gradually raised, is kept at the boiling point for an hour and a half, or two hours, during which the cloth is turned through the boiling liquor on a winch, that the mordant may be equally applied; and being afterwards taken out and drained, it is commonly left until the next day, and then rinsed in clean water, for dyeing. In the early collection of recipes, printed in 1605, and already mentioned, sour bran liquor is commonly directed to be employed in this way with alum; and it seems to have answered the purpose of tartar, which, when it came to be generally used in this way with alum; was supposed by the older dyers to do good by softening and correcting the acrimony of the latter: probably, however, the purposes which it answers, are not yet clearly ascertained; one of them seems to be that of increasing the solubility of alum, and enabling it more completely and intimately to penetrate the fibres of the wool, with which it moreover enters into a permanent union, and thereby con-

tributes efficaciously to modify, vary, and in some cases to brighten the colours with which it is employed, as will be seen hereafter."

Liechti and Suida¹ have studied the behaviour of aluminum tartrate. Starting with an amount equivalent to eight per cent. aluminum sulphate, $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$, referring to the wool, the whole of the alumina was fixed firmly on the wool. On treating the wool with hot water, the wasi water became acid, showing that some tartaric acid was also taken up. The normal tartrate can be replaced without detriment by a mixture of one molecular weight of aluminum sulphate with 1.5-3.0 molecular weights of cream of tartar. If the normal tartrate is prepared by double decomposition, using the normal potassium sodium tartrate (Rochelle or Seignette salt) according to the equation,



the results were not as good as those obtained with the pure tartrate or with alum and tartar, in which latter case the bath contains some acid potassium sulphate in addition to the aluminum tartrate. "Since the general practical experience of dyers is that wool is better mordanted in an acid bath, it was thought possible, perchance, to replace the cream of tartar by an acid, sulphuric acid, for instance. Experiment showed, however, that although a small addition of sulphuric acid (1 mol) increases slightly the amount of alumina absorbed by the fibre, it cannot replace the cream of tartar. Since the addition of a larger amount of sulphuric acid (3 mols) yields very unsatisfactory colours although it hinders the dissociation of the mordant solution, it is evident that the beneficial action of the cream of tartar cannot be ascribed merely to its retarding the dissociation of the mordant." The explanation undoubtedly is that the use of tartrate cuts down the degree of adsorption of the sulphuric acid.

1 *Mitt. techn. Gewerbe-Museums in Wien, Sektion für Färberei*, 3, 48 (1886); *Jour. Soc. Chem. Ind.*, 4, 526 (1886); *Knecht, Rawson and Loewenthal: "A Manual of Dyeing,"* 237 (1910).

1 Bancroft: "Philosophy of Permanent Colours," 1, 384 (1813).

(To be Continued.)

BASIC SLAG.—THE CHANGE IN ITS COMPOSITION.

REPORT BY CHAS. F. JURITZ, M.A., D.Sc.,
F.I.C., CHIEF, DIVISION OF CHEMISTRY.

(From the Journal of the Department of
Agriculture, July, 1922.)

A considerable change has come over the composition of basic slag since the war, whereby its grade has been lowered. The subject has been given serious attention in England, and the Imperial Minister of Agriculture in July, 1920, appointed a committee to study the basic slag problem, with Dr. E. J. Russell, the Director of the Rothamsted Experimental Station, as chairman. Towards the close of 1921 this committee submitted an interim report, which has not yet been published.

The change of composition is due to the fact that in the steel industry the basic Bessemer process, of which basic slag was a by-product, has now been superseded by the basic open-hearth process, and the character of the by-product has been entirely altered, its phosphate content having been halved.

INVESTIGATIONS IN ENGLAND.

The terms of reference placed before the Departmental Committee, which comprised steelmakers, fertilizer manufacturers, and farmers, were "to consider the development and improvement of the manufacture of basic slag and the extension of its use." The committee has up to the present discussed such questions as these: (1) the quantity of slag producible under present conditions; (2) how much slag can be advantageously utilised by farmers in Britain; (3) how the quantity or quality of the slag may be increased by combining with the ordinary manufacture of steel some subsidiary process; (4) what the agricultural value of the present quality of slag is.

(1) Before the war the annual output of high-grade slag in Britain was 260,000 tons. In 1920 it was only 46,000 tons. It may be of interest to tabulate the whole of the 1920 output according to grade:—

	tons.
Over 15 per cent. phosphoric oxide	46,000
12 per cent. and under 15 per cent.	121,000
10 per cent. and under 12 per cent.	91,000
7 per cent. and under 10 per cent.	302,000
5 per cent. and under 7 per cent.	118,000
Under 5 per cent.	23,000
Total	701,000

In addition to the 46,000 tons of high-grade slag—and it will be remembered that, according to our own definition, high-grade slag must contain not 15 but 16 per cent. of citric-soluble phosphoric oxide, and in the above table not only the citric-soluble but all the phosphoric oxide is included—there was only 212,000 tons of lower-grade slag that would have been allowed on our market at all, even under our relaxed war-time regulation No. 11. This quantity would not even suffice the British farmer, and precludes all idea of export. As for the 23,000 tons below 5 per cent., it would not be worth grinding.

(2) As far as the second point discussed by the committee went, it was estimated that the farmers of the United Kingdom ought to have been using 890,000 tons of basic slag annually, even before the war.

(3) Regarding the augmentation of the phosphate in the slag from subsidiary sources (a) some experiments were carried on by adding rock phosphates in the proportion of $\frac{1}{2}$ cwt. per ton of the slag in the fused state, but there was not sufficient alteration of the rock phosphate to justify the process, and the committee decided that such an addition could only be justified if it improved the character of the rock phosphate added. (b) The use of iron ore containing more phosphorus or the addition of phosphates in the blast furnace was considered, but from the steel manufacturer's point of view this would add to the cost of production of the steel, and could, therefore, be adopted only if the price of the resulting slag were sufficiently attractive. The matter is still under consideration. (c) Another point remaining under consideration is the reintroduction of the two lowest grades of slag into the blast furnace so as to increase the phosphatic character of the pig-iron, and thus produce a higher-grade slag.

(4) The committee arranged for experiments to be carried out at Rothamsted to elucidate—

(a) Whether the soluble and insoluble open-hearth slags differ in agricultural value, and, if so, whether some method of evaluation can be devised better than the present citric acid method;

(b) whether the present open-hearth slags are inferior to the pre-war Bessemer slags when applied in quantities of equal phosphatic content;

(c) whether finely ground mineral phosphates differ greatly in value from basic slag;

(d) whether the manurial effect of basic slag is wholly dependent on its phosphate content, or whether other constituents (manganese, etc.) should be considered of value.

Up to six months ago no conclusion had been arrived at on the first three of these points, and on the fourth the results lent no support to the idea that manganese is of value.

THE QUESTION OF SOLUBILITY.

In the January, 1922, issue of the *Journal of the Ministry of Agriculture*, Dr. E. J. Russell says that "in days before the war farmers were always urged to purchase only high soluble slag, and the grades sold by the best firms had a solubility of 80 per cent. and upwards. During the war the process of manufacture changed, and it is an open secret that the experts are no longer so much in agreement as they were in regard to the desirability of a high soluble slag. Experiments have been initiated to obtain more definite information, and until these are completed it is not possible to lay down precise rules for the farmers' guidance. In the meantime it is wise to assume that a high soluble slag will usually come into action more quickly than one of low solubility, and that a larger return may therefore be expected in the first season. It is possible, however, that in later seasons the low soluble slag may grow in effectiveness, and at the expiration of five years there may be little difference between the two; in some experiments, *e.g.*, in Essex, this is clearly demonstrated. Until more definite evidence is forthcoming, perhaps the safest assumption the farmer can make is that high-soluble slag may pay him interest on his outlay almost from the beginning, while the returns from low-soluble slag may be deferred."

By high-solubility and low-solubility in this quotation, it may be explained, is meant the proportion of citric-soluble to total phosphoric oxide in a slag, and not necessarily the high or low proportion of soluble phosphoric oxide to the slag as a whole.

In the Essex experiments comparative tests were made of the following two fertilizers:—

Class of Fertilizer.	Proportion of Citric-Soluble in Total Phosphoric Oxide.
Open-hearth basic slag	20 per cent.
High-grade basic slag	91 per cent.

The produce of two types of soil sown with clover resulted as follows:—

	Soil No. 1.		Soil No. 2.	
	Open-hearth Slag.	High-grade Slag.	Open-hearth Slag.	High-grade Slag.
	p.c.	p.c.	p.c.	p.c.
Clover ...	27	50	44	46
Grass ...	45	33	32	47
Weeds ...	16	14	14	1
Bare ...	12	3	11	5

Dr. Russell's comment on this was that "the crop returns show that high-grade slag is, as a matter of fact, rather better than low-grade, especially in improving the quality of the herbage. The difference is not so great as would be expected from the difference in solubility, and it seems clear that present-day analytical methods do not deal satisfactorily with present-day slags."

Such, then, is the position to-day. We have not yet come to the stage of finality in the matter. It is true that general buying conditions on the basis of 16.1 per cent. citric-soluble phosphoric oxide cannot now be reached, but then we do not ask for such a basis, even in our existing unrelaxed regulations—"12 per cent. of phosphoric oxide soluble in citric acid" is the minimum limit laid down by Regulation No. 11. On the other hand, it must be borne in mind that not only has the total percentage of phosphoric oxide in slag diminished, but even of that reduced total a much smaller proportion than before is soluble in citric acid.

Although, therefore, I think that the regulations need amendment,* it will never do to relax them to an extent that will permit of the unrestricted sale in this country

of material which may later on be shown to possess but the scantiest agricultural value.

THE TEMPTATION OF ADMIXING.

There is another consequence of the altered quality of basic slags to which I wish to draw attention. The temptation to admix other phosphates has obviously become greater than it used to be, and quite recently the term "slag phosphate" has been applied in England to a mixture of basix slag and mineral phosphate which has appeared on the British market. Dr. Russell has issued a warning to farmers to be careful to realise exactly what these words stand for when they are used.

Mixtures such as these have not yet, as far as I know, made their appearance in South Africa, but doubtless they will not be long in coming, and in the meanwhile I may also draw attention to a note published in the *New Zealand Journal of Agriculture* about three months ago by the New Zealand Agricultural Chemist to the effect that phosphate rock from Nauro and Ocean Islands has been sold to a Welsh basic slag company for the purpose of grading up their slag, and that the British Ministry of Agriculture has recommended farmers to try this mixture of slag and phosphate rock on their grass lands, and to lay thereby a good foundation for arable land. Regarding this mixture, too, experiments are in progress, both in Great Britain and in New Zealand, and for the present it only lies with us to differentiate between it and true basic slag.

** The Regulations were amended by Government Notice No. 963 of the 14th June, 1922, which provides that the minimum content in basic slag of phosphoric oxide soluble in citric acid shall be 10 per cent. instead of 12 per cent.*

THE ALTERED COMPOSITION OF BASIC SLAG.

(From the Journal of the Department of Agriculture, July, 1922.)

Basic slag, a by-product from the manufacture of steel, is a fertilizer rich in lime and phosphates, and large quantities are imported into the Union, as will be seen

from the following table, which gives the importations in tons of 2,000 lb.:—

1913	5,970 tons.
1914	6,832 tons.
1915	9,027 tons.
1916	6,231 tons.
1917	636 tons.
1918	Nil.
1919	1,920 tons.
1920	5,120 tons.
1921	1,905 tons.

These quantities, however, are still far below what it is estimated the Union requires annually of this fertilizer, the conditions set up by the war and the high prices which followed being the cause of the decreased importations. Basic slag is being used chiefly for grain crops in the south-west districts of the Cape Province, the chief wheat-producing area of the Union, where it is a valuable fertilizer for sour soils: it is found useful also in maize growing in certain of the soils of the Transvaal, but it is not extensively employed for this purpose at present, for economic reasons.

Anything concerning an article of such importance in South African agriculture as basic slag (known also as Thomas' phosphate or Thomas' slag), will be of interest to farmers, and an article on the subject, written by Dr. Juritz, the Chief, Division of Chemistry, is published in this issue of the *Journal*. For since the war a considerable change has come over the composition of basic slag, owing to a new process being employed in steel manufacture, with the result that the character of the by-product has been entirely altered, its phosphate content having been halved. This, of course, affects the value of basic slag, and experiments are being carried out in England with a view, among other objects, to increasing the quality and quantity of slag produced by combining with the ordinary manufacture of steel some subsidiary process. A stage of finality has not yet been arrived at in the adjustment of the matter under the changed conditions, but the position as it appears to-day is explained by Dr. Juritz, and should be studied by farmers who are using, or who are contemplating the use of, the fertilizer. In so far as the sale of basic slag in the Union is concerned, there was a regulation to the effect that it must contain at least 12 per cent. of phosphoric oxide soluble in citric acid. Owing to war conditions, this percentage was reduced, as a temporary measure, to

10 per cent., but in view of the present position, this lower percentage has now been fixed by the Government, so that in future (or until such time as it may be found advisable to make other provisions) the minimum phosphoric oxide content allowed in the sale of basic slag will be 10 per cent.

UNIVERSITY OF LONDON.

SENATORIAL ELECTION, OCTOBER, 1922.

Dr. George Senter, D.Sc. (Lond.), Ph.D. (Leipzig), F.I.C., Principal and Head of the Department of Chemistry, Birkbeck College, has been selected by the University of London Graduates' Association as candidate for the vacancy in the representation of Science Graduates on the Senate of the University of London, caused by the election of Dr. Walmsley as Chairman of Convocation.

GENERAL NOTES.

INTERNATIONAL INSTITUTE OF AGRICULTURE, ROME.

BUREAU OF STATISTICS.

The International Institute of Agriculture communicates that last month's favourable forecasts in regard to the crop in the United States have been, in the main, confirmed by the reports recently to hand from the Washington Department of Agriculture. The earliest estimates of Canadian crops, now received by the International Institute, are equally favourable.

The aggregate yields in these two principal exporting countries may therefore be estimated at 31.5 million metric tons of wheat, 3.0 million tons of rye, 5.4 of barley and 25.5 million of oats.

In comparison with 1921, there is an increase of 5.8 per cent. for wheat, 49.8 per cent. for rye, 17.4 per cent. for barley, and 16.2 per cent. for oats.

On the other hand, the yield of maize in the United States, usually amounting to about three-fourths of the world's crop of this grain, is at present estimated at 7 per cent. below the final out-turn of 1921, but nevertheless is slightly above the preceding five years' average.

The data of European yields of bread-stuffs (wheat and rye) are so far published only for Belgium, Bulgaria, Spain, Fin-

land, Greece, Hungary and Poland. The aggregate estimates for the countries mentioned amount to 7.4 million metric tons of wheat and 7.3 million tons of rye, showing a decrease of 10 per cent. as regards wheat but an increase for rye of nearly 10 per cent. as compared with the corresponding productions in 1921.

In North Africa (Morocco, Algeria, Tunis) the crops of wheat and barley this season are decidedly below those of last year, as they have suffered from drought.

The aggregate crops of these countries (0.8 millions metric tons of wheat, and 0.9 millions metric tons of barley) are only 48 per cent. of those in 1921.

Summing up the data of those countries which have furnished official estimates of their wheat yield (about 65 per cent. of the aggregate for the northern hemisphere) we obtain a wheat crop of 49.5 million metric tons, being 7 per cent. more than that grown in 1921, and 9 per cent. over the average of the previous five years. These percentages will probably undergo some reduction, as it is well known that the cereal yield in some of the principal European countries is likely to be less than in 1921.

A fresh telegram from the United States' Government has reached the Institute at the last moment, indicating by reports up to 15 July some improvement in most of the crops in the United States. Some excellent yields have been ascertained from wheat threshings in the South, but the quality is rather low and the crop usually less than expected. Maize has improved materially in the south-east, but is still below average in condition. Potatoes and tobacco are generally good. Cotton is making good progress.

PURCHASE OF ARSENIC.

Dr. McDonald further asked the Minister of Health if, in view of the fact that large quantities of arsenic could be obtained from chemists by individuals merely signing a poison book, he would take steps to discontinue this practice.

Sir A. Mond replied: The sale of arsenic is governed by Sections 1 and 2 of the Arsenic Act, 1851, and by Section 17 of the Pharmacy Act, 1868. It would require

further legislation, which will be considered, to deal with the point raised by the hon. member.

SCIENTIFIC INSTRUMENTS

Mr. Raffan asked the President of the Board of Trade whether he had received the report of the committee appointed by him to deal with the application for a further duty of 33½ per cent. upon optical and scientific instruments; whether the terms of reference to this committee included the consideration of employment in the making of dental, surgical, and medical instruments; if so, whether evidence on this point was submitted to the committee; and whether the value of imports of dental, surgical, and medical instruments during the six months ending June, 1922, and similar figures for the same period in 1921.

Mr. Baldwin replied: The answer to the first part of the question is in the negative. The complaint referred to the committee does not relate to dental, surgical and medical instruments other than a very limited number, which are included in the lists of optical elements, and of optical and scientific instruments issued by the Board of Trade under section 1 (5) of the Act. These particular goods are products of industries covering a much wider range, as to employment in which the committee were specifically directed to report, and their report, when presented, will no doubt deal with this aspect of the matter. The declared value of dental, surgical, medical and veterinary instruments (except optical) registered as imported into the United Kingdom during the six months ending June 30, 1922, was £12,427. The corresponding value for the six months ending June 30, 1921, was £20,592.

KANNENSTINE, FABIAN M.—Formation and Life of Metastable Helium. *Astrophysical Journal*, 55, 345-353, May, 1922. The University of Chicago Press, Chicago, Ill.

Abstract.

Current-potential curves for alternating and intermittent arcs in pure helium between a Wehnelt cathode and nickel anode

were obtained by use of a Braun-tube oscillograph, for pressures of from 0.06 to 2 mm. With alternating voltages, the striking potential for each half-cycle was 29 volts or more for frequencies of 200 or less, but for frequencies of 220 cycles and above, the current started at about 5 volts and soon reached a saturation value until about 25 volts caused a further increase. In all cases the breaking potential was about 5 volts. To form the intermittent arc, the voltage was periodically dropped from 36 to some lower predetermined value. If this lower potential was less than 4.6 volts, the arc was suddenly extinguished; if between 4.6 and 23.7 volts, the arc died out gradually; and if it was 25.3 volts or above, the arc was maintained. All the foregoing values include a correction of 1.1 volts added to the actual readings to bring them in agreement with accepted results.

Evidence as to the life of metastable helium.—To explain various experimental results, it has been suggested that atoms of helium, partially ionized by electronic collisions of 20.8 volts or more and hence capable of complete ionization by further impacts of 4.8 volts or more, remain in this metastable condition for an appreciable time. The foregoing results not only confirm this suggestion, but also show that under the circumstances of this experiment the metastable form persists for about 0.0024 second.—GORDON S. FULCHER.

CHILD, C. D.—A Continuous Spectrum from Mercury Vapour. *Astrophysical Journal*, 55, 329-344, May, 1922. The University of Chicago Press, Chicago, Ill.

Abstract.

Continuous spectrum of mercury, red to ultra-violet.—(1) *Conditions for emission in discharge tube.* A continuous spectrum identical with the fluorescence spectrum is emitted in addition to the ordinary line spectrum only when (a) the temperature of the vapour is above 120° C. and below 300° to 400°, depending on the pressure, when (b) the pressure is above 1 mm., when (c)

the current-density is low, of the order of 10 amp. cm. or less, and (d) when very little air or other contaminating gas is present. An influence machine or transformer is better as a source of current than an induction coil, especially one with condensers. Ionization of the vapour is not necessary for the emission of this spectrum since it was obtained with only 7 volts between the Wehnelt cathode and surrounding cylinder. (2) *In explanation* it is suggested that the carriers of the spectrum are molecules consisting of two or more atoms, which emit the fluorescence spectrum as a result of excitation by ultra-violet radiation λ 2536 emitted by atoms struck by electrons with energies corresponding to 4.9 volts or more.

Continuous spectrum of sodium.—Preliminary observations on heated sodium vapour in a discharge tube indicated that a continuous spectrum was present but much fainter than the line spectrum.

Ionization potential for mercury.—Some observations on the current from a heated filament to a concentric electrode as a function of voltage seem to show that the ionization potential varies with the temperature, reaching a minimum for about 140°, when it was 3 volts less than for 50°.

Change in chemical behaviour of mercury vapour at about 120° C.—Above that temperature it reacts with air to form a dark compound, but not below. This reaction is associated with the appearance of the continuous spectrum. — GORDON S. FULCHER.

RAMSAY MEMORIAL FELLOWSHIPS.

The Ramsay Memorial Fellowship Trustees have awarded a Ramsay Fellowship of the value of £300, tenable for one year, but renewable for a second year, to Mr. Robert Winstanley Lunt, Ph.D., of the University of Liverpool, and of University College, London. Mr. Lunt will continue to undertake chemical research at University College, London, on Chemical Effects of Electromagnetic Waves over the Frequency range 10-10 cycles.

The Trustees have awarded the Glasgow Ramsay Fellowship of £300 to Mr. John Alexander Mair, B.Sc., of Glasgow Univer-

sity, who will continue his research on the Chemistry of the Terpenes.

The Trustees have also granted a special Fellowship of £300 for one year, to Mr. William Davies, M.Sc., who has already held a Ramsay Fellowship for two sessions, and whose work, especially that on the preparation of synthetic reagents from the toluic acids, shows special promise.

The Danish Ramsay Fellowship has been awarded to Mr. Kristian Høejendahl, of the University of Copenhagen, who will pursue his research in the University of Liverpool.

Two Swedish Ramsay Fellowships have been awarded to Dr. J. O. G. Lublin and Mr. A. W. Bernton respectively.

Two Norwegian Ramsay Fellowships have been awarded to Mr. Dag Nickelsen, who will work at the Imperial College of Science and Technology, and Miss Milda Prytz, who will work at University College, London.

The Trustees have placed at the disposal of the National Research Council of the United States of America a special Ramsay Fellowship of the value of £350; and Dr. Charles G. Piggot, of Baltimore, has been elected to that Fellowship, and will begin work at University College, London, in October.

University College,

27 July, 1922.

Gower Street.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

PASS LIST.

July Examinations, 1922.

The following Associates have passed the examination for the Fellowship:—

In Branch A II., Metallurgy (1 entered and passed): Oakley, Percy Dale, B.Sc. (Lond.).

In Branch E., The Chemistry, including Microscopy, of Food and Drugs and Water

(4 candidates entered of whom 2 passed): Essery, Reginald Ernest, B.Sc. (Bris.); Wahmsley, James Rawson, A.M.C.T.

The following candidates have passed the examination for the Associateship:—

In General Chemistry (45 candidates entered, of whom 28 passed): Bateman, Alan Hamilton, Birkbeck College, London; Berchem, Rudolph Otto George Alexander, Birkbeck College, London; Brow, William Thomas, B.Sc. (Edin.), Heriot-Watt College and the University, Edinburgh; Carmichael, Kenneth Francis, Heriot-Watt College, and the University, Edinburgh; Cooler, Harold Frederick, East London College; Crawley, Ailsa Victoriana, University College, London; Easterbrook, William Caulton, Royal Technical College, Glasgow; Eastland, Cyril Jack, School of the Pharmaceutical Society; Fairgrieve, Jessie Helen Carroll Dick, Heriot-Watt College, Edinburgh; Fritz, Jack, Leeds Central Technical School; Grant, James, Heriot-Watt College, Edinburgh; Haslam, Margaret Mary, B.Sc. (Lond.); Herd, Clifford Walter, University College and Sir John Cass Technical Institute, London; Kekwick, Leslie Oliver, University College, London; Luke, James Trewhella, King's College, London; Mathie, John Richardson, Royal Technical College, Glasgow; Maunder, Archibald George Daw, University College, London; McGregor, Percy, Heriot-Watt College, Edinburgh; Melhuish, Barradale Whiddon, School of the Pharmaceutical Society; Miller, Herbert Frederick, Birkbeck College, London; Mitchell, Robert Edward, South Western Polytechnic, London; Polglaze, Gordon Henry Francis, King's College, London; Richardson, William Robert, University College, London; Rigden, Horace Walter; Schorn, Edwin John, Heriot-Watt College, Edinburgh; Stokoe, Hector Vivian Thurlbeck, B.Sc. (Lond.), Armstrong College, Newcastle-on-Tyne; Tucker, John Morgan, University College, London; Wallace, Dorothy Orford (Nat. Sci. Tripos, Cantab.), Girton College, Cambridge.

Under Regulations in force prior to March, 1920.

In Branch (a), Mineral Chemistry (4 entered, of whom 2 passed): Cutting, Percival Harman; Laing, Thomas Edward, South Western Polytechnic, London.

In Branch (d), Organic Chemistry (4 entered, of whom 3 passed): Dodds, George Elliot, Heriot-Watt College, Edinburgh; McCartney, William, Heriot-Watt College, Edinburgh; Renton, Archibald, Heriot-Watt College, Edinburgh.

In Branch (e), The Chemistry, including Microscopy, of Food and Drugs and Water (3 entered, of whom 1 passed): Pearson, Margaret, South Western Polytechnic and Battersea Polytechnic, London.

By Order of the Council,

RICHARD B. PILCHER,

Registrar and Secretary.

30, Russell Square, London, W.C.1.
July 28th, 1922.

CHROMIUM HYDROXIDE (AIR DRIED).

By A. J. W. FOSTER.

It was thought that Chromium Hydroxide probably contained water of constitution. The following experiment was therefore performed:—

Pure Chromium Hydroxide was obtained by precipitation with an alkaline hydroxide from a Chromium Salt. The precipitate was filtered at the pump and was well washed. The wet mass was placed on clean filter papers and was exposed to the air till thoroughly dry. A weighed quantity of the dry substance was then ignited in a crucible and the loss in weight determined.

This was repeated three times. The percentage of water in the original substance was then easily calculated, and then the formula obtained in the usual way.

0.99 gm Chromium Hydroxide	
lost 0.49 gm water.	% water 49.49
1.415 gm Chromium Hydroxide	
lost 0.695 „ „	% water 49.11
1.67 gm Chromium Hydroxide	
lost 0.825 „ „	% water 49.40
Average % water 49.33.	

This agrees with formula $\text{Cr}_2\text{O}_3 + 8 \text{H}_2\text{O}$
or $2 \text{Cr}(\text{OH})_3 + 5 \text{H}_2\text{O}$.

Woodleigh, Mytholmroyd, Yorks.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs can be obtained gratuitously.

Latest Patent Applications.

- 19422—Ashcroft, E. A.—Treatment of sulphide ores, &c. July 14.
 19405—Backstrom, H. M.—Apparatus for catalytic oxidation of ammonia with oxygen. July 14.
 18897—Dietzsch.—Treatment of copper ores. July 10.

Specifications Published This Week.

- 163975—Aluminium Co. of America.—Method of manufacturing aluminium chloride.
 158569—Soc. E. Barbet et fils et Cie.—Evaporating apparatus.
 182411—Courtaulds, Ltd., and Jones, R. O.—Effecting the separation of sodium carbonate from liquors or solutions containing caustic soda

Abstract Published This Week.

Sulphuric acid.—Patent No. 180546.—Some improvements in the apparatus and process of manufacturing sulphuric acid has been invented by Mr. E. A. Gaillard, of 33, Ronda Universidad, Barcelona, Spain. A stream of cold acid is made to trickle permanently over the whole inner surface of the walls of the lead chambers or towers for the purpose of protecting them from corrosion. Preferably chambers are constructed as cylinders, or reversed truncated cones, cold acid being directed on to the walls by a turbine of resistant material placed axially near the top of the chamber and fitted with jets or wings to ensure the wetting of the whole inner surface. Nitrous vitriol may be introduced into the chamber in the same way.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

UNIVERSITY OF BIRMINGHAM.

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Arts: Subjects—Latin, Greek, English, French, German, Italian, Spanish, Russian, Philosophy, History, Music.

Medicine: All subjects leading to Degrees and Diplomas in Medicine and Dentistry.

Commerce: Subjects leading to Degrees in Commerce.

Department of Training for Teachers:
 Department of Social Study:

Department of Malting and Brewing.

THE SESSION 1922-23 COMMENCES
 ON OCTOBER 2nd, 1922.

ALL COURSES AND DEGREES ARE
 OPEN TO BOTH MEN AND WOMEN
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In the Medical School, Courses of Instruction are arranged to meet the requirements of other Universities and Licensing Bodies.

Graduates, or persons who have passed Degree Examinations of other Universities may, after one year's study of research, take a Master's Degree.

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6. Department of Biology and Chemistry of Fermentation.
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THE CHEMICAL NEWS,

VOL. CXXV., No. 3253

A NEW PHYSICO-CHEMICAL LAW.

By HAWKSWORTH COLLINS.

The Heat of Formation of an Element is Proportional to the Product of the Atomic Weight and the Change of Volume.

The following 8 tables give:

- (1) the atomic weights of several elements;
- (2) the observed Specific Gravities of the same;
- (3) the observed Specific Gravities of several common molecules; and
- (4) the observed Heats of Formation of the same.

From these four sets of data,

- (1) the Relative Volumes of the elements, when in combination, are deduced; and also
- (2) the Heat of Formation of each element, when combining to form molecules.

The theoretical results never differ by more than 1 per cent. from the observed.

The relative volumes and the theoretical heats of formation have been found not only from the data here employed, but from hundreds of others.

These results are proved to be true from the fact that the heat of formation of each element of atomic weight greater than 22 is proportional to the product of its atomic weight and its change of volume.

There are some apparent exceptions to this at present, probably owing to mistakes in the observed heats of formation. For the general method of obtaining these is by finding one of them and then calculating others from it. For instance, in the case of Strontium, the compound SrCl_2 was first determined by Thomsen, and then all the other compounds of Sr calculated from it. The consequence is that, if SrCl_2 is wrong, then they are all wrong. Again, even if SrCl_2 is correctly determined, it does not follow that the others are right, because the relative volume of Sr in SrCl_2 may not be the same as that in another compound.

Again, Thomsen takes it for granted that the acid radicals (SO_4 , e.g.) are always the same in all compounds, which does not

happen to be the case. The total relative volume of SO_4 varies in certain definite manners.

The heat of formation of each element of atomic weight less than 22 is also proportional to the product of its atomic weight and its change of volume; but there is a great difference between the two series of elements, as shown by the numbers 795 and 120.

The truth of the law is also evident from other considerations as follow:—

- (1) Whenever Oxygen occupies the volume 7.53, its heat of formation is 32341.
- (2) Whenever O occupies the vol. 4.45, its H.F. is 71515.
- (3) Whenever O has the vol. 2.51, its H.F. is 96155.
- (4) These 6 numbers for the R.V. and H.F. of Oxygen all give the same original relative volume for Oxygen, which proves that a deep-seated discovery has been made with regard to them.
- (5) Whenever other elements have two or more relative volumes in combination, their heats of formation are always proportional to the change of volume, and therefore give the same original volume, which in its turn gives the correct S.G. of the element.

The tables are intended to be employed in the following manner, the molecules numbered 1—4 being taken as examples:—The S.G. of PbO is given by Geuther as 8.74-9.09. If $206+16$ be divided by 8.9, the result is 24.95, which splits up into 17.42 and 7.53; the former being a common volume for Pb, and the latter a common one for Oxygen.

The H.F. is given as 50800 by an American publication. If 50800 be taken as the value, this number can be split up into 32341 (which is always the H.F. corresponding with Oxygen when its volume is 7.53) and 18500. The latter portion splits up into $120 \times 0.75 \times 206$, where 206 is the atomic weight of Pb, and 120 is a constant. If 0.75 be added to 17.42, the result is 18.17, and if 206 be divided by 18.17 the result is 11.34, which is exactly the S.G. of Pb.

If similar operations be performed in the cases of the other three compounds of Pb., it will be seen that the original relative volume of the element in each case is 18.17, which gives the correct S.G. of the element Pb in the solid state.

An exactly similar state of affairs is shown to exist in several other common molecules, whenever the experimental data required are complete.

It is evident from the large number of mathematical operations which have to be performed upon the experimental data with regard to each element and molecule, that there is no possibility of error in the deduction that the H.F. of an element

varies as the product of the atomic weight and the change of volume.

The "change of volume" here means the difference between the volume of the element in the solid state at 15° C. and the volume of the element when in combination with others at 15° C. Consequently the experimental data with regard to such elements as Cl, Br and O are, and apparently must remain, incomplete as far as this discovery is concerned.

TABLE I.

Relative Volumes.		Theoretical.	Observed S.G. and Observer.
1. PbO (red)	17.42+7.53	8.9	8.74-9.09 Geuther
2. PbCl ₂	19.39+2(15.085)	5.59	5.29 Monro 5.68 Karsten
3. PbI ₂	19.39+2(27.73)	6.14	6.12 Rodwell
4. PbCO ₃	19.81+20.55	6.59	6.60 Smith
5. Sb ₂ O ₃	2(21.29+2.51)+4.45	5.5	5.251 P & J 5.566 Mons
6. Sb ₂ O ₅	2(21.29+2.51+7.53)+4.45	4.74	6.525 Boullay 3.78 P & J
7. Sb ₂ S ₃	2(21.29+10.51)+15.53	4.22	4.223 23° Cooke
8. ZnO.H ₂	11.53+7.53+2.51+2(5.76)	2.99	2.68 Nickles 3.06 Filhol
9. ZnF ₂	11.53+2(5.33)	4.64	4.612 12° Clarke
10. ZnI ₂	12.6+2(27.73)	4.69	4.696 Bodeker
11. Cu ₂ S	2(9.05)+10.51	5.522	5.521-5.795 Scheerer
12. Cu ₃ I ₂	2(9.74)+2(27.73)	5.07	4.41 Schiff 5.7 Rodwell
13. As ₂ O ₃	2(19.58+2.51)+7.53	3.83	3.85 Claudet
14. MoO ₃	15.53+2(2.51)	6.23	6.44 16° Monro 5.67 Bucholz
15. HgCl ₂	17.05+2(15.085)	5.72	6.223 P & J 5.42 Boullay
16. HgI ₂	16.62+2(27.73)	6.29	6.27 Tschermak 6.32 Boullay
17. Bi ₂ O ₃	2(24.29)+3(2.51)	8.3	8.5 Dumas 8.21 Herapath
18. NaHCO ₃	11.85+5.76+20.55	2.20	2.205 Schroder 2.192 P & J
19. Na ₂ CO ₃	2(11.85)+20.55	2.40	2.407 Favre
20. Fe ₃ O ₄	3(11.65)+3(2.51)+4.45	4.94	4.960 Gerolt
21. Fe ₃ O ₄ (cryst)	3(10.08)+2(2.51+4.45)	5.25	5.25 Gorgeu
22. Fe ₂ O ₃	2(11.65+2.51)+4.45	4.9	4.679-5.135 P & J
23. SnO	18.08 + 2.51	6.51	6.6-6.45 0° Ditté
24. SnO ₂	18.08+2.51+4.45	6.0	6.019 (artif cryst) Leeds
25. CdSe	14.57+11.25	7.32	8.8 Little 5.80 Margottet
26. CdO	15.16+2.51	7.19	8.11 Werther 6.95 Karsten
	Cr ₂ O ₃ 2(8.78)+3(2.51)	6.06	6.2 Schiff 5.21 Wohler(cryst)
28. Cr ₂ O ₃	2(8.78+2.51)+4.45	5.62	6.2 Schiff 5.21 Wohler
	CaS 12.24+15.53	2.59	2.58 Maskelyne
30. CaBr ₂	12.24+2(23.09)	3.39	3.32 11° Bodeker
	CaCO ₃ 13.25+20.55	2.96	2.938-2.995 Breithaupt
32. CaO	13.25+4.45.	3.164	3.161 Karsten 3.18 Filhol
	CaO 14.33+2.51.	3.325	3.32 Levallois
34. NiO	8.13+4.45	5.96	5.597 P & J 6.398 Bergemann
	CoF ₂ 11.45+2(5.33)	4.39	4.43 V N
36. Ag ₂ O	2(13.61)+2.51	7.74	7.521 Schroder 8.26 Karsten
	Ag ₂ S 10.25+13.61+10.51	7.16	7.164 Dauber
38. CeO ₂	19.20+2(2.51)	7.16	7.09 14° Nordenskiöld 7.65 V N
	SiBr ₄ 18.91+23.09+3(27)	2.83	2.813 0° Pierre
40. WO ₃	12.89+2(2.51)	12.06	12.11 Karsten
	Ta ₂ O ₅ 2(21.98)+5(5.21)	7.86	7.986 Rose 7.653 Rose
42. ThO ₂	13.62+7.53+4.45	10.32	10.22 17° Nilson

P & J = Playfair & Joule.
C K = Chemiker Kalender.

V N = Van Nostrand.

TABLE II.

Theoretical Heat of Formation.		Observed H F		
1. PbO (red)	+18500+32341	=	50841 50800 50300	T
2. PbCl ₂	-30200+2(56132)	=	82064 82770	T 83900
3. PbI ₂	-30200+2(36227)	=	42254 41850 39800	T
4. PbCO ₃	-40607+210765	=	170158 170000 166700	
5. Sb ₂ O ₃	-2(48200)+(2(96155)+71515)	=	167425 166900	
6. Sb ₂ O ₅	-2(48200)+2(96155+32341)+71515	=	232107 231200	
7. Sb ₂ S ₃	-2(48200)+2(49959)+30681	=	34199 34400	
8. ZnO ₂ H ₂	-14900+32341+96156-2(15300)	=	82996 82680	T 83500
9. ZnF ₂	-14900+2(76820)	=	138740 138220	
10. ZnI ₂	-23233+2(36227)	=	49231 49230	T
11. Cu ₂ S	-2(14907)+49959	=	20145 20300 18260	T
12. Cu ₂ I ₂	-2(20083)+2(36227)	=	32288 32520	T
13. As ₂ O ₃	-2(35000)+2(96155)+32341	=	154651 154670 156400	
14. MoO ₂	-50900+2(96155)	=	141410 142800	
15. HgCl ₂	-57400+2(56132)	=	54864 54490	T 53300
16. HgI ₂	-47000+2(36227)	=	25454 25200 25640	T
17. Bi ₂ O ₃	-2(75200)+3(96155)	=	138065 139200	
17. NaHCO ₃	+32706-15300+210765	=	228117 227000	
19. Na ₂ CO ₃	+2(32706)+210765	=	276177 273700 272640	
20. Fe ₃ O ₄	-3(31570)+3(96155)+71515	=	265270 265200	
21. Fe ₃ O ₄	-3(21000)+2(96155+71515)	=	272340 270800	
22. Fe ₂ O ₃	-2(31570)+2(96155)+71515	=	200685 199150	
	SnO -28040+96155	=	68115 68090	
24. SnO ₂	-28040+96155+71515	=	139630 137200 141300	
	CdSe -23200+47045	=	23845 23700	
26. CdO	-31000+96155	=	65155 66300 63900	crys
	Cr ₂ O ₃ -2(10364)+3(96155)	=	267737 267800	cryst
28. Cr ₂ O ₃	-2(10364)+2(96155)+71515	=	243097 243800	amorph
	CaS +64420+30681	=	95101 94300	
30. CaBr ₂	+64420+2(45244)	=	154908 154920	T
	CaCO ₃ +59568+210765	=	270333 270800 269100	
32. CaO	+59568+71515	=	131083 131500	
	CaO +54376+96155	=	150531 151900	
34. NiO	-10000+71515	=	61515 61500 57900	
	CoF ₂ -32920+2(76820)	=	120720 120340	
36. Ag ₂ O	-2(45080)+96155	=	5995 5900	T 7000
	Ag ₂ S -45080-1900+49959	=	2979 3000 3330	T
38. CeO ₂	+32290+2(96155)	=	224600 224600	
	SiBr ₄ -24600+45244+3(17000)	=	71644 71000	
40. WO ₃	-60060+2(96155)	=	132250 131400	
	Ta ₂ O ₅ -2(88500)+5(96155)	=	303775 301500	
42. ThO ₂	+219000+32341+71515	=	322856 326000	

T = Thomsen. The other values are taken from an American publication, the names of the observers not being given.

Stubbington House,
Fareham, Hants.

(To be Continued.)

ALUMINA.

HYDROLYSIS OF ALUMINUM SALTS.

By Wilder D. Bancroft.

(From the *Journal of Physical Chemistry*, June, 1922.)

(Continued from Page 72.)

"An experiment was made accordingly with a view to determining whether the tartaric acid used along with aluminum salts played the rôle of a carrier, so that it might be possible to use any free acid along with only a small quantity of tartaric acid. The result obtained, however, proved that the tartaric acid plays no such intermediary part in mordanting wool with aluminum salts; on the contrary, a considerable amount of tartaric acid must be present (at least half the theoretical amount necessary to form aluminum tartrate) in order to fix on the wool sufficient alumina to yield full, bright colours."

Knecht¹ evidently believes in starting with aluminum sulphate. "The aluminum mordant *par excellence* for wool is aluminum sulphate, either alone or in conjunction with acids or acid salts. In some cases the sulphate is used without any additions. Most generally, however, a mixture of the sulphate with tartar or tartar substitutes is required to obtain full and brilliant colours which do not rub off. These tartar substitutes are mostly sodium bisulphate or oxalates, or they consist of tartar which has been prepared with sufficient sulphuric acid to convert all the potassium into potassium sulphate. From the foregoing it appears that none of these "substitutes" can replace the tartar completely because the action of the latter depends on the formation of aluminum tartrate by double decomposition. They have, of course, some effect, as has also sulphuric acid. For a full shade about 6 to 8 per cent. aluminum sulphate and 5 to 7 per cent. tartar (of the weight of the wool) are necessary. The quantity of tartar may be reduced to about half this amount, or it may be partly or even wholly replaced by sulphuric, hydrochloric, oxalic acid, bisulphate of sodium, etc., with very good, although not equally fine, results. About 4 per cent. of sulphuric acid (of the weight of the wool) is used, if the amount of water

does not exceed 50 to 60 times the weight of the wool; otherwise more acid must be applied. When sulphuric acid has been used in mordanting it is often beneficial to add about 5 per cent. sodium acetate to the ultimate dye-bath to neutralise the mineral acid which always remains in the wool fibre (and which otherwise would be converted into potassium sulphate if tartar had been employed). The mordanting bath is prepared with the necessary quantities of aluminum sulphate and tartar (or its substitutes), and the wool is entered at a low temperature. During one and a half hours the bath is heated gradually to boiling, and boiled for half an hour more. When the bath has cooled down, the wool is taken out and thoroughly washed in water; boiling out with water is beneficial. It has been shown that washing is absolutely necessary to remove all loosely adhering mordants and to prevent rubbing of the ultimate colour. The washing, moreover, removes some of the acid, which is absorbed by the wool, and would be injurious in dyeing."

I am inclined to believe that accurate experiments will show that the presence of sulphate in the mordanting bath is probably always detrimental.

Aluminum oxalate behaves very much like aluminum tartrate, but is not quite so good. According to Knecht¹ aluminum acetate decomposes too readily to be used for wool; but this can hardly be the whole truth. The use of lactic acid instead of tartaric acid has also been suggested.

Matthews² has rather a hard time with the theory of mordants, chiefly because he copies with but slight changes from Ganswindt's book published in 1903. "The mordanting of the animal fibres with metallic salts is probably for the most part a chemical process, the metallic salts or oxide forming a chemical compound with the substance of the fibre. It is usually considered in the case of mordanting wool, for instance, with metallic salts, that the metal is precipitated in the fibre as the oxide or hydroxide; in certain methods of printing, this may be the fact, but in the ordinary processes of mordanting wool for dyeing, it cannot be considered that the oxide of the metal is directly precipitated

1 Knecht, Rawson and Loewenthal: "A Manual of Dyeing," 238 (1910).

1 Knecht, Rawson and Loewenthal: "A Manual of Dyeing," 237 (1910).

2 "Application of Dyestuffs," 602 (1920).

in the fibre. It is possible, for instance, to mordant the wool by boiling in a bath containing a solution of alum, squeezing, and then passing through a bath containing ammonia water; this would cause the precipitation of aluminum hydrate on and in the fibre as an insoluble body. As an actual fact, however, the mordanting is not done in this manner, but is carried out by boiling the wool with a solution of alum and tartar, which it cannot be presumed would lead to the precipitation of aluminum hydrate."

Even with Ganswindt to fall back on in silence, this paragraph is quite extraordinary; but the clue is to be found elsewhere. Matthews¹ has evidently not understood any of the work of Liechti and Suida or of Knecht, because he enters into an elaborate explanation that sodium chloride is dissociated electrolytically in water and thereby made more active, giving this as a help in understanding the theory of Knecht, although Knecht² himself speaks of hydrolytic dissociation, and the case that Matthews is discussing is the decomposition of rosaniline hydrochloride into the free base and hydrochloric acid, which is not a case of electrolytic dissociation.

ADSORPTION OF ALUMINA BY SILK.

Silk behaves towards alumina mordants very much as wool does, though less intensely. Knecht³ states that "in silk dyeing alum has not been replaced yet by aluminum sulphate⁴ probably owing to the circumstance that slightly basic alum decomposes more readily than basic sulphate on account of the ammonium or potassium sulphate present. . . . Aluminum sulphate-acetate and nitrate-acetate are used in a similar way. . . . During the steeping process the silk absorbs basic sulphates or basic sulphate-acetates or nitrate-acetates. By the subsequent treatment with water or silicate of soda or soap, the basic salts are decomposed and aluminum hydroxide is precipitated in the fibre." Heermann⁵ claims to have proved that,

with silk, the basic mordants of aluminum, chromium, iron and tin are present as hydrous oxides and not as basic salts. Heermann¹ has discussed the various theories of mordanting, and mentions favourably what he calls the catalytic theory according to which the fibres bring about the hydrolytic decomposition of the mordanting salts catalytically. It is easy enough to see what he has in mind, for the hydrolysis of the aluminum salts is increased by wool or silk; but this cannot properly be called catalytic, because the fibre is not in the same condition after the process as before. It is mordanted.

Heermann also advances a theory of his own which he calls the ionatic theory of mordanting. He considers mordanting "as the electrolytic precipitation of certain ion complexes in consequence of the preponderating electro-affinity² of the fibres (as opposed to that of the cations of the mordant) and in consequence of the [electrolytic?] dissociation of the mordant which is perhaps increased by the catalytic power of the fibres or of the cations of the mordant."

This can mean anything or nothing, so Heermann explains his views in more detail. "There are fibres of greater and lesser electro-affinity and mordants of greater and lesser electrolytic dissociation. The affinity of a mordant to a fibre reaches its maximum when the greatest difference between the electro-affinities of the fibre and of the ions of the mordant. The fibre, having the greater electro-affinity, discharges successively the ions or ion-complexes of the mordant, since these have a lesser electro-affinity. The ion-complexes of the mordant, since these have a posit themselves, while in the nascent, state, uniformly on the fibre and are at first held there in a labile state along with the acid. Washing removes most of the acid of the mordanting salt, and the resulting base is fixed fast to washing." It is perhaps not surprising that no further use has been made of this theory even by the enthusiastic author.

ADSORPTION OF ALUMINA BY COTTON.

Over a century ago it was pointed out that "the attraction between aluminous

1 Knecht, Rawson and Loewenthal: "A Manual of Dyeing," 15 (1910).

2 "Application of Dyestuffs," 588 (1920).

3 Knecht, Rawson and Loewenthal: "A Manual of Dyeing," 238 (1910).

4 Both are used according to Ganswindt. "Theorie und Praxis der modernen Färberei," II., 18 (1903).

5 Chem. Centralblatt, 1905, I., 128

1 *Ibid.*, 1904, II., 674.

2 [He is referring to Bodländer and Abegg's theory of electro-affinity.]

3 Bancroft: "Philosophy of Permanent Colours," 2, 148 (1813).

basis and the fibres of linen and cotton is much weaker than that which subsists between the same basis and the fibres of wool and silk." The knowledge that alum cannot be used by itself to mordant cotton turns back to a very early period. Bancroft¹ states that "when a solution of alum is applied to calico which has received no impregnation, it will not easily be decomposed; but, on the contrary, a great part of it will again crystallise, so soon as the water which held it in solution has evaporated; and none but feeble colours can be raised upon such a basis. But when calico has been impregnated by such astringent and animal matters as are obtained from myrobalans and buffaloes' milk, the alum will not only be decomposed, but the alumine will combine with the astringent and oily matters so obtained, and a basis will be laid for a colour almost as durable as the Turkey red."

For the common madder red, linen or cotton, after being boiled in a weak lixivium of potash or soda, and well rinsed and dried, is to be macerated in a decoction of powdered galls, employed after the rate of four ounces to every pound of linen or cotton to be dyed; and being equally impregnated with the soluble matter of the galls and afterwards dried, the linen or cotton is to be alumed, by soaking it thoroughly in a saturated luke-warm solution of alum, employed also at the rate of four ounces to each pound of linen or cotton; after having previously neutralised the excess of its acidity, by adding to the solution one ounce of soda for every pound of alum: this being done, and the linen or cotton moderately and equally wrung or pressed, it is to be well dried, and afterwards alumed a second time, dissolving for that purpose half as much alum as for the first aluming, and adding to it the residue of the former solution. After this second aluming, the linen or cotton is to be again well dried, and then rinsed, to remove any superfluous part of the alum which may not have been united thereto. By substituting the acetate of alumine (formerly described) for the solution of alum, just mentioned, a more beneficial effect might be obtained; but it would be attended with a considerable increase of expense.

"The use of galls, in this operation, will be readily conceived, by recurring to what I have mentioned, at p. 356 and 357 of my first volume, concerning the effect of myrobalans, when employed by the Hindoos, in

causing a more copious precipitation, and a more intimate union of the earth of alum, in or with the calico which had previously imbibed their astringent matter. That this is the only use of galls so employed, I presume, because I have found, by repeated trials, that when employed with madder in the dyeing operation, they add nothing to the durability of the colour.

For every other purpose, except that of decomposing the alum, and increasing the precipitation of alumine, and, perhaps, its closer union with the fibres of cotton, galls appear to do harm rather than good with madder, by diminishing the vivacity of its colour, and giving it a brownish tinge, without the smallest increase of its durability; on the contrary, I have observed, that when calico printed with acetate of alumine was divided, and one half dyed with madder only, and the other with madder and galls, the colour of the latter, besides a considerable degradation, was injured by being boiled with soap and also by being exposed to the weather sooner, and in a degree considerably greater than the half which had been dyed with madder only."

Napier¹ points out that "alum forms but a weak mordant for cotton goods, owing, probably, to the strong attraction which the sulphuric acid has for the alumina; there are three proportions of acid to every two of alumina. But if we neutralise a portion of the acid, so that no more remains than is necessary to hold the alumina in solution, which, according to experiment is not above a third of the acid contained in the common alum, its properties as a mordant are greatly improved. This may be done by taking a quantity of carbonate of soda in solution, and adding this gradually to the alum solution, stirring all the time: the alumina is at first precipitated, but by keeping up the agitation the precipitate again dissolves: continue until all the precipitate is redissolved. In this state alum is a more powerful mordant for cotton, as the base is held more feebly by the sulphuric acid, and is readily detached by the superior affinity of the cloth to form a mordant; and thus prepared, it is perfectly pure—any iron formerly present is precipitated in the process. Alum in this state is known by the name of cubical or basic alum, from the form in which it crystallises. We have already referred to Roman alum being superior to other alums."

¹ "Philosophy of Permanent Colours," 1, 357; 2, 242 (1813).

¹ "A Manual of Dyeing," 120 (1975).

PREPARATION OF SILENT SPIRIT.

(Journal of Indian Industries and Labour.)

Ordinary rectified spirit possesses, besides the smell of alcohol, an odour characteristic of the raw material used in its manufacture. For example, a spirit made from *mahua* flowers will have a characteristic smell in addition to the odour peculiar to pure alcohol; a spirit made from sugar molasses will disclose its peculiar smell besides that of pure alcohol, and so on. This extraneous odour, which persists in the spirit in the absence of a special treatment for its removal, is considered, for apparent reasons, objectionable in spirits intended to be employed in perfumery preparations.

At the instance of the Industries Department, experiments have been carried out at the Muir Central College, Allahabad, on the preparation of silent spirit from ordinary rectified spirit obtained from *mahua* or molasses. The experiments were carried out under the supervision of Professors A. C. Sircar and S. C. Deb, and the products were examined by the Industrial Chemist to the Government of the United Provinces and found to satisfy the requirements of a silent spirit and to compare favourably with any of the foreign samples of silent spirit available in India. The prescriptions worked out are as follows:
Experimental—

(1) A solution of 12 grammes of potassium permanganate in 100 cc. of water was prepared, 4 cc. of this solution was added to a litre of the alcohol sent and the mixture was kept for two days. A black precipitate was formed from which the alcohol was carefully decanted. It was then kept over quicklime overnight, and finally distilled. Recovery of alcohol was about 85 to 90 per cent. by volume. The specific gravity of the sample thus prepared was 0.788 at 33° C. It compared favourably with the silent spirit (specific gravity 0.794).

(2) 10 grammes of caustic potash were added to a litre of alcohol and the mixture was kept overnight. Next day the mixture was boiled under a reflux condenser for about an hour. The contents of the flask were then distilled and kept over quicklime overnight and finally re-distilled. Recovery of alcohol was about 88 per cent. by volume.

(3) Flax stems were burnt and about 4 oz. of porous charcoal obtained. Any good specimen of purified porous charcoal will serve the purpose as well. The charcoal thus obtained was washed with water to get rid of colouring matter. It was dried and kept in a desiccator till required, when it was put inside a stoppered cylindrical funnel, and about 250 cc. of alcohol to be deodorised was made to percolate through it eight times. The alcohol became nearly odourless. It was, however, slightly coloured owing to traces of colouring matter still left in the charcoal. It was then filtered through 4 oz. of purified animal charcoal. The specific gravity of the product was 0.82.

E. R. WATSON.

CATALYTIC OXIDATION OF SATURATED HYDROCARBONS AND FATTY ACIDS.

A. H. SALWAY AND P. N. WILLIAMS.

This paper contains the results of the oxidation of stearic acid in the presence of manganese stearate as catalyst. A current of oxygen was passed through the acid in the presence of 2 per cent. manganese stearate at 120°-130° C., and the resultant products carefully collected. They consisted of 5 per cent. volatile acids (1 per cent. CO₂, 2.5 per cent. H.COOH, and 1.5 per cent. other acids, including acetic and higher fatty acids). Three per cent. of water soluble acids were obtained, consisting of formic, butyric and acetic acids (average molecular weight 74). The main oxidised product was washed and found to have acid value 206 and sap. value 244 indicating the presence of lactonic substances. These were extracted, and the lactones are considered to have the general formula

$$\text{CO}_2\text{H} \cdot [\text{CH}_2]_n \cdot \text{CH} \cdot \text{CH}_2 \cdot \text{CH}_2 \cdot \text{CO}.$$


Hexadecane was also oxidised at 120° C. in the presence of 2 per cent. manganese stearate, by passing through it a current of oxygen for 24 hours, 4 per cent. of volatile acids were formed (CO₂, H.COOH, CH₃COOH and butyric acids). The main oxidised material consisted of 70 per cent. acid substances and 30 per cent. unchanged hexadecane, the former containing hydroxy acids in the form of a pale yellow oil, and value 241, iodine value 0.7, S.G. 0.9611. Hexoic and nonoic acid are possibly present, also lactonic acids.—(*J.C.S. Trans.*, 1922, p. 1343).

NOTES ON OSMIRIDIUM.

By J. R. THURLOW.

[The following interesting note on the occurrence of Osmiridium in South Africa is given in the May issue of the *Journal of the Metallurgical and Mining Society of South Africa*.]

In view of the interest which is being taken in osmiridium, to judge by the frequent references appearing in the local press, no apology is needed for placing before the members of this Society a brief record of what has been done locally hitherto, and more particularly the results which have been obtained during more recent research on this valuable constituent of blanket ore.

The first serious attempt at commercial realisation known to the writer was made by the late Mr. M. Torrente during the period 1912-13, when he succeeded in isolating and fusing into metallic form a small quantity of the metal iridium. Mr. Torrente carried out a considerable amount of research work on concentrated black sand, resulting from milling operations from one of the mines in the Central Rand, and, with a view to establishing commercial relationships, was in correspondence with well-known firms in England and on the Continent for some considerable time.

The next and more successful attempt of this kind occurred during the latter part of 1920 on a mine situate in the Eastern Rand section. It may be noted, however, that periodically during the intervening period more or less frequent references were made to the fact of the presence of rare metals other than gold in concentrated products resulting from metallurgical operations. In the main, however, these references were concerned mostly with analytical work; quite frequently it was a subject for argument in connection with the assaying of concentrates dealt with by the Co-operative Smelting Works.

The nearest approach to its successful isolation from the commercial aspect, viewed in light of present-day knowledge, would appear to be when a small quantity, containing 80 per cent. osmiridium and 3 per cent. platinum, was passed round for inspection at a meeting of this Society, held in October, 1915,* when Messrs. W. H.

Jane and F. Davey presented a paper on clean-up room practice.

The history of the 1920 incident is worth recording as an instance of the benefit resulting from scientific training and its natural outcome in the shape of an intelligent interest in whatever work is being undertaken. The curiosity of an assayer led to a discussion as to the nature of a certain blue-black material which he had observed to form a ring round the outer edge of the material passing through a batea. As a sequel a small portion was collected which, on analysis, proved to contain a high percentage of osmiridium. Subsequent investigation indicated that a natural concentration of this product was occurring in the clean-up room, and advantage was taken of its incidence to evolve an economical process of recovery.

After a good deal of experimental work in the direction of hydraulic concentration the simple system described herein was adopted, and meanwhile gradual improvements are taking place which lead to increased efficiency.

In connection with the experimental work it may be mentioned that a magnetic process was tested, and while it was found that osmiridium was attracted with the magnetic metallic iron to the various poles, probably due to the magnetic film covering, no real concentration was effected.

A description of the method referred to above as employed on reduction plants of the Rand Mines Central Mining Group is as follows:—

Proceed in the usual manner to grind in the clean-up barrel all black sands collected from the amalgamation plates and the products from the traps, mortar box heads, Wilfley tables, etc. Pass the ground material through the batea also as usual, but take precaution to keep the final heavy concentrates remaining on the batea separate from the lighter portion which flows over the trap plate. By this means a product containing 40 per cent. of osmiridium concentrate has been obtained, and where this is possible the simplest method of further treatment is to pan off the base metals in a prospector's dish. The most satisfactory method at present of dealing with the product from the collecting sump of the batea is to pass it over a small table, which is covered with open-grained calico resting on fine mesh (100) screen.

*See "*Journal*," October, 1915, page 67. *et sequentes*.

The dimensions of this table may be made to suit the working space available; the tables at present in use are about 5 feet long by 2 feet wide, and are made with a small head box and distributing lip similar to those situated at the heads of the tube mill plates. The inclination of the table depends upon the material being concentrated, and the operator can soon decide what this should be to obtain the best result. A grade of 20 per cent. is found to work very well, but as the table is usually a portable one and only set up as required, it can readily be adjusted to suit working conditions. The concentrate caught on the table is further dressed by panning, and the product of this operation is treated by acid. It may be pointed out that as all operations prior to concentration on the calico-covered table are contributory to the ordinary routine, the operating charges per ton of ore treated are practically unaffected.

The following table gives typical analyses of the results obtained by the above means after the product had been subjected to treatment with weak acids:—

	1	2	3	4
	p.c.	p.c.	p.c.	p.c.
Iridium	43.9	44.51	37.86	33.25
Osmium ... {	11.9	10.50	10.04	10.47
Ruthenium . {		25.38	34.75	37.79
Platinum ..	3.0	7.04	6.37	5.80
Rhodium ...	1.3	0.53	0.82	0.70
Gold	3.0	3.09	3.60	2.86
	93.1	91.05	93.44	90.87

Analyses by R. A. Cooper, Rand Mines, Ltd., Laboratory.

The following copy of a complete analysis of "Black Sand" was given to the writer by the late Mr. M. Torrente:—

	%
Iron	35.32
Sulphur	41.27
Copper	0.35
Lead	0.03
Nickel	0.20
Cobalt	0.24
Zinc	0.48
Arsenic	0.33
Silica	19.65
Alumina	0.50
Chromium Oxide	0.08
Lime	0.17
Magnesia	0.12
Titanium Oxide	0.95
Oxygen, Combined and Hydroscopic Water, Gold and Metals of Platinum Group	0.61
	100.00

Fine Gold ... 1.33 ozs. per ton of 2,240 lbs.
 Fine Silver 2.00 ozs. per ton of 2,240 lbs.
 Platinum ... 0.43 ozs. per ton of 2,240 lbs.
 Iridium 3.00 ozs. per ton of 2,240 lbs.
 Palladium .. 0.45 ozs. per ton of 2,240 lbs.

On sample as received.

As regards the amount of osmiridium present in the ore milled, tests have shown that it varies from 1 ounce per 5,000 tons to 1 ounce per 15,000 tons.

Taking the mean of these extremes, to arrive at a monthly output of 100 ounces osmiridium 1,000,000 tons would have to be milled. The computation is made on tests carried out on mines situated on the Far East Rand. So far only negligible quantities have been isolated on mines west of the Modder Group.

COMMERCIAL VALUE.—The most valuable constituent of the concentrate is iridium, which, however, is subject to violent fluctuations in price according to demand. Thus it realised £120 per ounce two years ago, as compared with one-fifth of this amount per ounce more recently.

COMMERCIAL USES.—The chief uses of osmiridium or the metals contained therein have hitherto been:—

- (1) Fountain pen points.
- (2) Contacts used in magneto points of the highest class of motor cars.
- (3) Iridio-platinum alloy used in thermocouples.
- (4) Hardening parts of certain dental instruments.
- (5) Watch and compass bearings.

RECENT ATTEMPTS TO SEPARATE ISOTOPES.

Abridged from the Journal de Chimie Physique, XIX., 4, 336.

(Continued from Page 39.)

While the separation of isotopes by centrifugation was not attempted until 1920, the method of gaseous diffusion, which depends upon the direct relation between the mobility of the molecules and their mass had already been tried in 1913 with neon by F. W. Aston, and in 1919 with hydrogen and oxygen by O. Stern and M. Volmer. Aston's work, which was begun immediately after the complex nature of neon had been demonstrated by J. J. Thomson, after a long series of diffusions through porous walls, gave two extreme fractions, the densities of which differed by

weights 20.15 and 20.28 $\pm$ 0.02 differing by -0.25 per cent. 0 $\pm$ 0.10 per cent. from the atomic weight of atmospheric neon (20.20). On the other hand the experiments of Stern and Volmer, who tried to decompose hydrogen and oxygen by diffusion, in the hope of explaining by isotopism the fractional value of the ratio of the atomic weights of these two elements, led to absolutely negative results, agreeing, moreover, with the data given by the method of mass-spectra. During the last two years the method in question has been applied to chlorine by W. D. Harkins and A. Hayes, to iodine by E. Kohlweiler, and to mercury by J. N. Brösted and G. V. Hevesy.

The work of Harkins and Hayes was the continuation of a series of experiments begun in 1916 by the first of these authors, in collaboration with W. D. Turner, which experiments were interrupted during the last years of the war and were taken up again in 1919 with T. H. Liggett and C. E. Brocker. Except for some preliminary experiments in which chlorine commercial was used as material, the fractionation was performed with gaseous HCl, prepared by the action of sulphuric acid upon pure concentrated hydrochloric acid. The diffusion was carried out at atmospheric pressure, the gas being led into tubes of materials of different porosity. The apparatus finally employed enabled several thousands of litres to be diffused in a day. The course of the fractionation was followed by comparing the densities and molecular concentrations of the aqueous solutions of hydrochloric acid prepared with the original acid, and the acid which was obtained after diffusion. Each specimen of gaseous acid was submitted before examination to a complete purification by fractional distillation. The densities were determined by means of a quartz pycnometer of capacity 22 cc. placed after being filled in a thermostat regulated to about 0.001°. The balance used was sensitive to 0.02 mg. The molecular concentrations of the acid solutions were obtained by titration with one hundredth normal caustic soda (titration by weight). Three residues of diffusion were examined corresponding to 5.9 and 90 gr. of chlorine. The combining weight of chlorine was found to be 35.515 for the first residue (mean of five determinations), and 35.498 for the second, and 35.494 for the third. The augmentation was thus 0.155 per cent.

0.107 per cent., and 0.096 per cent. referred to the normal value, 35.46.

In the experiments of Kohlweiler relating to the separation of the hypothetical isotopes of iodine, it was not the residue after diffusion that was examined, as in Harkins' work, but the diffused fraction. Iodine vapour was passed into a glass tube kept at a temperature of 220° and having 16 partitions of porous material in the interior. Conveniently arranged absorbers, consisting of carbon disulphide, retained the fraction diffusing most rapidly and then the less dense. After 768 consecutive diffusions the lightest fraction was subjected to seven density determinations by Dumas' method. The density was found to be about 0.6 per cent. less than that of the vapour of ordinary iodine, determined in the same experimental conditions. According to the author, this result confirms his predictions relating to the existence of several isotopes of iodine. It must be noted, however, that according to Aston's observations, iodine is certainly not a complex element. Hence Kohlweiler's positive result should be regarded, provisionally at any rate, as doubtful.

In the attempts of Brinsted and v. Hevesy to separate the isotopes of mercury by fractional diffusion, the metal was heated to 105° in a glass bulb, the neck of which was connected with two test-tubes, one after the other, cooled by means of ice. The one nearest the bulb was closed at the top by a sheet of platinum pierced with a thousand holes of diameter 0.15 mm. The greater part of the mercury vapour condensed in the second test-tube, and only a small fraction in the first, after having diffused through the platinum sieve. Only one single series of experiments seems to have been carried out with this apparatus. The density of the diffused mercury was 0.0013 per cent. lower than that of the ordinary metal. This difference is very small, but the authors regarded their measurements of density as correct to 0.0001 per cent. approximately. We shall return to this point when discussing attempts to fractionate mercury by evaporated and rapid condensation, a method also employed by Brinsted and v. Hevesy.

(To be continued.)

PROCEEDINGS AND NOTICES OF SOCIETIES.**IMPORTANT NOTICE.****CHEMICAL SOCIETY.**

*Burlington House,
Piccadilly, W.1.*

ROLL OF HONOUR.

In view of the preparation of the Roll of Honour, the Council desires to ensure that the names of all those Fellows who have been killed in action or who died on service should be included therein.

The following names are those so far received, and Fellows are invited to notify the Assistant Secretary by August 31st of any names that have been omitted.

Andrea Angel, (date of death) January 19th, 1917; John Percy Batey, April 9th, 1918; Charles Maurice Berlein, June 16th, 1915; Bertram Haward Buttle, October 1st, 1917; Norman Phillips Campbell, May 3rd, 1917; Frederic William Caton, June 28th, 1916; Cecil Reginald Crymbe, November 20th, 1914; John Llewellyn Davies, September 26th, 1915; Charles William Dick, November 9th, 1918; John Gunning Moore Dunlop, August 27th, 1914; Charles Geo. Edgar Farmer, August 14th, 1916; James Louis Foucar, May 8th, 1915; Edward William Lanchester Foxell, June 11th, 1917; Ivan Richard Gibbs, September 27th, 1915; Edward Frank Harrison, November 4th, 1918; John Maxwell Heron, March 26th, 1917; Charles Cochrane Iles, December 19th, 1914; Richard Arnold Seymour Jones, March 27th, 1915; Maurice Kemp-Welsh, April 11th, 1917; Herbert King, October 7th, 1917; Frank Stevenson Long, September 26th, 1915; James McConnan, December 20th, 1916; Cyril Douglas McCourt, October 8th, 1916; Raymond William Nichols, October 26th, 1916; Leonard Ison Pitt, July 30th, 1915; Benjamin Ashwell Posford, February 25th, 1915; William Gilbert Saunders, September 6th, 1916; Arthur Edwin Tate, April 22nd, 1917; Cecil Hamersley Waldron, March 2nd, 1916.

**ROYAL AGRICULTURAL SOCIETY
OF ENGLAND.****GENERAL MEETING IN SHOWYARD.**

Proceedings at General Meeting, held in the large tent in the showyard at Cambridge on Wednesday, July 5th, 1922, H.R.H. the Duke of York, K.G. (President), in the chair.

PRESIDENT'S OPENING REMARKS.

H.R.H. the Duke of York, in opening the meeting, said:—My Lords, Ladies and Gentlemen,—It is a great pleasure to me to be here in my position as President at the annual general meeting of the Royal Agricultural Society on the occasion of the annual show being held in my old university town. (Applause.) This is the third time the show has been held at Cambridge, and in this connection it is gratifying to note the wonderful increase, both in size and importance, both of the Society and of the show, since the first show took place here in 1840. (Hear, hear.) Without entering into too many details, the show has increased in extent from the 5 acres which it then occupied on Parker's Piece to over 120 acres on the magnificent site so generously placed at our disposal by my old College of Trinity. The prize money, from from the £900 of that date, has risen to the £13,800 which is being offered at this show, while the entries of live stock and implements have swollen to an amount which admits of no comparison with the two previous shows held in Cambridge. The most striking thing of all is the membership of the Society, which has increased from the 3,000 of the year 1840 to the wonderful total of 13,375. I hope that the mournful prophets who seek to impress upon us that British agriculture has had its day will read and realise the significance of these remarkable figures. Eighty-three "new implements" are entered for the Society's silver medal, and this, I think, reflects the greatest credit upon the inventive genius and progressive spirit of agricultural machinery manufacturers. This is all the more creditable considering the differences which have taken place in the engineering trade and the lack of demand by foreign countries for agricultural implements, which must have lessened the incentive for invention that is so necessary for the creation of anything which is new. I heartily congratulate the implement ex-

hibitors on the remarkable way they have overcome all these difficulties and on the assembly of such a wonderful show of machinery.

Turning to the live stock section, the recent outbreak of foot-and-mouth disease, which spread so rapidly throughout the country, must have caused the owners of valuable stock to think very seriously before deciding to send their animals to the show. Their courage is greatly to be admired, and I trust it has had its reward in the prizes gained by them in the various sections. The forestry, horticultural, education and bee sections are well represented. Therefore, in spite of the difficulties, to which I have alluded, in the implement and live stock sections, the Cambridge Show has created a record of entries, and the Society and exhibitors are greatly to be congratulated on the fact that the show promises to be a most successful one.

As on former occasions, the county, the town, and the University have vied with each other in giving to the Society a very cordial welcome. Resolutions will be submitted to you tendering the thanks of the Society to the various bodies which have contributed so largely to the success of the show, and they will, I feel sure, meet with your cordial approval. I cannot, however, allow this opportunity to pass without referring to the vast amount of work which your Honorary Director, Sir Gilbert Greenall—(applause)—has done in the preparation, organisation and administration of this show, and to his expert knowledge and untiring energy. In the name of the Society I would like to thank him.

THE BOROUGH POLYTECHNIC
INSTITUTE, BOROUGH ROAD,
LONDON, S.E.1.

CHEMISTRY DEPARTMENT.

Session, 1922-23, commencing Monday, 25th September, 1922. Enrolment nights for all departments: Monday, Wednesday, and Friday, 18th, 20th, and 22nd September.

Special arrangements have been made for courses for students who wish to work for the National Certificate in Chemistry, sanctioned by the Board of Education and the Institute of Chemistry. The course of lectures on the Chemistry of Foodstuffs

will be given this session by Mr. A. E. Parkes, F.I.C., formerly chief chemist to Messrs. Lipton, Ltd.

Afternoon classes in Chemistry applied to the laundry industry.

For further particulars apply to the Principal.

IRON AND STEEL INSTITUTE.

President: DR. J. E. STEAD, F.R.S.

YORK MEETING, SEPTEMBER 5TH TO 8TH,
1922.

A full programme of events has been arranged, particulars of which can be obtained from the Secretary, 28, Victoria Street, S.W.

The following is the list of papers which it is expected will be submitted at the meeting:—

L. AITCHISON: *The Changes of Volume of Steels During Heat Treatment. 1: Air Hardening Nickel Chromium Steels*).

L. E. BENSON: *Nitrogenisation of Iron and Steel by Sodium Nitrate*.

E. D. CAMPBELL: *A Brinell Machine Attachment for Use with Small Specimens*.

E. D. CAMPBELL and — JOHNSON: *A Preliminary Magnetic Study of Some Heat-treated Carbon Steels*.

J. H. S. DICKENSON: *Some Experiments on the Flow of Steels; at a Low Red Heat, with a Note on the Scaling of Heated Steels*.

C. W. H. HOLMES: *An Investigation on the Factors Influencing the Grain and Bond in Moulding Sands*.

H. K. OGILVIE: *Practical Notes on the Manufacture and Treatment of High-speed Steel*.

A. K. REESE: *The Bases of Modern Blast Furnace Practice*.

G. A. V. RUSSELL: *Reversing Cogging Mills: Their Drives and Auxiliary Equipment*.

J. H. WHITELEY: *The Diminution of Lag Arising through Deformation*.

Members who desire to receive advance copies of any of the papers should make early application for them. Those who wish to attend the meeting should preserve their copies, as it may not be possible to supply additional copies at the meeting. It will oblige if members will limit their requests for papers to those only in which they are particularly interested.

THE INSTITUTE OF METALS

AUTUMN MEETING, SWANSEA, SEPTEMBER
19TH TO 22ND, 1922.

A very full programme of events has been arranged for each day, particulars of which can be obtained from the Secretary, 36, Victoria Street, London, S.W.1.

The following communications are expected to be submitted:—

Sixth Report to the Corrosion Research Committee of the Institute of Metals on *The Nature of Corrosive Action, and the Function of Colloids in Corrosion*. By GUY D. BENGOUGH, M.A., D.Sc., and J. M. STUART, M.A.

A Report to the Aluminium Corrosion Research Sub-Committee of the Corrosion Research Committee of the Institute of Metals on *Experiments on the Oxide Method of Determining Aluminium*. By J. E. CLENNELL, B.Sc.

PROFESSOR J. H. ANDREW, D.Sc. (Glasgow) and ROBERT HIGGINS (Glasgow), on *Grain-Size and Diffusion*.

F. L. BRADY, M.Sc. (Birmingham), on *The Structure of Eutectics*.

MAURICE COOK, M.Sc. (Cambridge), on *The Antimony-Bismuth System*.

SIR HENRY FOWLER, K.B.E. (Derby). Note on *The Effect of Superheated Steam on Non-Ferrous Metals used in Locomotives*.

MARIE L. V. GAYLER, M.Sc. (Teddington), on *The Constitution and Age-Hardening of Alloys of Aluminium with Copper, Magnesium, and Silicon in the Solid State*.

F. W. HARRIS, M.Sc. (Teddington), on *The Hardness of the Brasses and some Experiments on its Measurement by Means of a Strainless Indentation*.

A. JEFFERSON (for the Sheffield Silver Trades Technical Society). Note on *The Cause of Red Stains on Silver-Plated Work*.

F. JOHNSON, D.Sc. (Birmingham), and W. GRANTLEY JONES (Birmingham), on *New Forms of Apparatus for Determining the Linear Shrinkage and for Bottom-Pouring of Cast Metals and Alloys, accompanied by Data on the Shrinkage and Hardness of Cast Copper-Zinc Alloys*.

Q. A. MANSURI, B.A., M.Sc. (Cambridge), on *Intermetallic Actions. The System Thallium-Arsenic*.

A. H. MUNDEY (London), C. C. BISSETT, B.A., B.Sc., B.MET. (London), and J.

CARTLAND, M.C., M.Sc. (Manchester), on *White Metals*.

W. ROSENTHAL, D.Sc., F.R.S. (Vice-President), and J. D. GROGAN, B.A. (Teddington), on *The Effects of Overheating and Melting on Aluminium*.

R. SELIGMAN, PH.D. (Member of Council), and PERCY WILLIAMS, B.Sc. (London). Note on *The Cleaning of Aluminium Utensils*.

D. STOCKDALE, B.A. (Cambridge), on *The Copper-Rich, Aluminium-Copper Alloys*.

Only members and student members will be entitled to participate in the Swansea meeting. For the convenience of applicants for membership who are desirous of being elected in time for the meeting, a special ballot is being arranged in connection with which membership application forms should be received by the Secretary not later than noon on Thursday, September 7th. The ballot will be concluded in time for members and student members so elected to participate in the meeting.

GENERAL NOTES.

PARLIAMENTARY INTELLIGENCE.

ARSENIC AND STRYCHNINE.

Sir Fortescue Flannery asked the Minister of Health if his attention had been called to the suggestion of one of His Majesty's judges that poisons in the form of powder, such as arsenic and strychnine, should be manufactured and sold only with distinctive colouring, and that white strychnine or arsenic powders should be no longer permitted; and whether the Government would introduce legislation to give effect to these suggestions.

Mr. Shortt, Home Secretary, replied: Yes, sir, inquiries are being made as to the practicability of employing distinctive colours for poisons. The investigation is not yet complete.

DYESTUFFS.

Mr. Galbraith asked the President of the Board of Trade whether any arrangements were being made or contemplated whereby

all profits made by the central importing agency out of the sales of German reparation dyestuffs on behalf of the Government were to be handed over to British dye makers.

Sir P. Lloyd Greame replied: No arrangements of the kind suggested have been made. Certain proposals for the assistance of the dye-making industry as a whole by the further co-operation of the dye-users and the State have, however, been tentatively put before the President of the Board of Trade, and he is in consultation with the Chancellor of the Exchequer on the subject.

SODIUM PYROPHOSPHATE.

Mr. Kiley asked the President of the Board of Trade if he was aware that one of the largest makers of patent food products, employing a considerable number of hands, who were large consumers of sodium pyrophosphate (cream of tartar substitute), a product scheduled in the key list under Part I. of The Safeguarding of Industries Act, 1921, were unable to meet competition for export business of foreign makers of similar products who obtained this raw material free of any duty, and was also handicapped in the home market by competitive firms consuming cream of tartar, a similar product which had been taken out of the key list by order of the referee, and in consequence had had to curtail their output and discharge a large number of workmen; and, if so, how much longer was it intended to levy duty on the imports of sodium pyrophosphate and hundreds of other articles which, on the referee's rulings on points of principle, were clearly outside the scope of Part I. of the Act?

Sir P. Lloyd Greame replied: No representations have been made to me that the action taken by the Board of Trade on the decision of the referee in the case mentioned has had any effect on the export trade of any company, or has curtailed output and caused unemployment. As regards the last part of the question, I am not aware of any decisions of the referee which would warrant the assumption made by the hon. member.

ANALYTICAL RE-AGENTS.

Mr. Hogge asked the President of the Board of Trade whether he was aware that, by the use of the words analytical re-agents

in the Safeguarding of Industries Act, 1921, certain heavy chemicals never intended to be taxed had to be taxed because they were used in comparatively minute quantities as analytical re-agents; that, in consequence, such a heavy chemical as hyposulphite of soda was taxed because a few hundred pounds, as compared with every 1,000 tons used industrially, was used as an analytical re-agent; whether he was in sympathy with this unexpected result of the Act; and, if not, what steps, if any, he proposed to take.

Sir P. Lloyd Greame replied: Such heavy chemicals as are prepared in a very high degree of purity for use as analytical re-agents are liable to duty only when of analytical re-agent or correspondingly special quality. As regards the second part of the question, hyposulphite of soda of the ordinary industrial grade is not liable to duty, but only the photographic quality. This is not an unexpected result of the Act, and consequently I do not propose to take any action in the matter.

TECHNICAL RECORDS OF EXPLOSIVES SUPPLY, 1915-18. No. 7.

MANUFACTURE OF NITRIC ACID FROM NITRE AND SULPHURIC ACID.

A special series of reports is being published for the Department of Scientific and Industrial Research in order to make available, for the benefit of the industries concerned, results of scientific and industrial value contained in the technical records of the Department of Explosives Supply of the Ministry of Munitions. The work recorded was done at or in connection with some of the National Factories during the war. The preparation of the necessary abstracts of information was begun by the Ministry of Munitions at the close of the war, and arrangements were afterwards made by the Department of Scientific and Industrial Research to complete them.

The present report embodies the results of very careful study and investigation of the conditions for working to the best advantage large-scale plant for the production of nitric acid from nitre and sulphuric acid. The subject is dealt with under the following sections:—

SECTION 1.—*Description of Plant and Process for Manufacture of Nitric Acid by Retort Process*: General outline; descrip-

tion of buildings and plant; plant operation; standardisation of retorts; desiderata in running the retort house; standard retort charges; diagram for use in charging nitric acid retorts; composition of the sodium nitrate used; determination of conditions for maximum output, condenser efficiency, &c.; summary of conclusions, and further trial run; further report on nitric acid plant with Hart condensers; thermal equilibrium in nitric acid manufacture by retort process; cracking of retorts.

SECTION 2.—*Nitric Acid Stills for Distillation of Spent Acid from the Manufacture of Nitro-cotton*: Discontinuous distillation; continuous distillation.

SECTION 3.—*Description of Plant and Process for Washing Nitre Bags*: General outline; description of plant; operation of plant; steam consumption; quantities dealt with; labour requirements; improved practice in bag-washing; outlines of a model bag-washing plant; cost of running nitre bag-washing plant.

The report described below has been published by His Majesty's Stationery Office for the Department of Scientific and Industrial Research. Copies, price 10s. 6d. (by post 11s.), may be obtained through any bookseller, or direct from H.M. Stationery Office.

FACTORY AND WORKSHOP.

DANGEROUS AND UNHEALTHY INDUSTRIES.

"The Chemical Works Regulations, July 11th, 1922, made by the Secretary of State under Section 79 of the Factory and Workshop Act, 1901 (1. Edw. 7, C.22) to apply to the manufactures and processes incidental thereto carried on in Chemical Works."

Printed and published by His Majesty's Stationery Office, to be purchased through any bookseller or directly from H.M. Stationery Office at the following addresses: Imperial House, Kingsway, London, W.C.2, and 28, Abingdon Street, London, S.W.1; 37, Peter Street, Manchester; 1, St. Andrew's Crescent, Cardiff; and 23, Forth Street, Edinburgh.

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The 31st Annual issue of this Directory has recently been published. It is a very carefully arranged volume of 950 pages, and contains all that there is to be known of the world's production of paper. It will be found of great value to all engaged in paper production and the allied trades. Much care appears to have been taken in the arrangement of the various sections of the work—these are arranged in alphabetical order. The publishers are to be congratulated upon having secured such a volume of information during the present period of commercial distraction, and as there appears to be sure hope of an early improvement the new edition is likely to be in great demand.

RECORD OF PHOTOGRAPHY.

ISSUED BY THE PROFESSIONAL PHOTO-GRAPHERS' ASSOCIATION OF GREAT BRITAIN AND IRELAND.

We have received a copy of the first issue of the above, together with two remarkably good photographs, one of Pirie MacDonald, and the other of Bairnsfather.

In a foreword by the Editors, George Hand, Marcus Adams, and Jenkyn Griffiths, it is explained that the chief object of the publication is to cater for the wants of the professional photographer, and to increase the membership of the Professional Photographers' Association. The issue contains a deal of interesting information, together with a full account of the proceedings of the Council of the P.P.A. The Secretary, Mr. Alfred Ellis, Professional Photographers' Association of Great Britain and Ireland, Ltd., 2, Vinery Villas, London, N.W.8, will be pleased to send particulars of membership on application.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs can be obtained gratuitously.

Latest Patent Applications.

- 19821—British Oxygen Co., Ltd.—Manufacture of sulphur dioxide. July 19.
- 19533—Chapman, E. B.—Catalyst strainers. July 17.
- 19553—Davis, J.—Oxy-chloride cement coverings. July 17.
- 19703—Johnson, J. Y.—Production of metaldehyde and obtainment of combustible substances thereof. July 18.
- 19546—Johnson, W.—Machine for drying and neutralising sulphate of ammonia. July 18.

Specifications Published This Week.

- 155776—Brutzkus, M.—Process for effecting chemical reaction in the interior of compressors.
- 159878—Norsk Hydro-Elektrisk Kvaestof-aktieselskab.—Process for the manufacture of ammonia.
- 182609—Burgess, L.—Process of reducing aluminium oxide.
- 165083—Farbenfabriken vorm. F. Bayer & Co.—Manufacture of new copper compounds substantive azo-dyestuffs.
- 182693—Hetherington, H.—Manufacture of lead chromate pigments.
- 172937—Barret Co.—Process for the purification of naphthalene.

Abstract Published This Week.

Lead Azide.—Patent No. 180605.—A process for obtaining lead azide, particularly for use in explosion composition, has been devised by Mr. W. Friederich, of Troisdorf, near Cologne, Germany, and patented in this country. It is obtained in mixed or double crystals with other substances such as basic lead azide, heavy metal hydroxides, carbonates, basic chlorides, and sulphates, and neutral and basic salts of nitrocompounds, for example, mono-di and trinitrophenols, di and trinitroresorcin, trinitrophenol-glucinol, trinitroaminophenol, metadinitroorthodinitrosobenzol, and hexanitrodiphenyl amine. The double crystals may be obtained by simultaneous or successive precipitation.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward post free for the official price of 1s. each.

City of Cardiff Education Committee.

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Principal: CHARLES COLES, B.Sc. (Lond.).
DEPARTMENT OF INDUSTRIAL CHEMISTRY.

Head of Department: H. W. WEBB, M.Sc., F.I.C., F.C.S.
SESSION 1922-23.

(Commencing on Tuesday, 3rd October, 1922).

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JOHN J. JACKSON,

Director of Education.

City Hall, Cardiff.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3254

A NEW PHYSICO-CHEMICAL LAW.

By HAWKSWORTH COLLINS.

(Continued from Page 83.)

The volume of the radical CO_3 is 20.55, which splits up into $8+7.53+2(2.51)$, where 8 is the volume of the carbon atom. The corresponding H.F. is 210765, which splits up into $-13886+32341+2(96155)$. (See Table VII. for the explanation of -13886.)

It is evident from Tables III. and VII. that whenever the change of volume is

negative, the H.F. is positive, and *vice versa*. This is true in every case investigated, without any exception.

This regularity alone makes it absolutely certain that the heat of formation is entirely due to change of volume; *i.e.*, when the volume of an element in combination is less than its original volume in the solid state, heat of formation is given out, and *vice versa*.

It would have been impossible to make this discovery if the three relative volumes of Oxygen had not previously been found, the details of which were sent to the Nobel Institute in 1914.

This matter affords another instance of the reason for the claim that the relative volumes are the fundamental constants of Nature.

TABLE III.

		Original Relative Volume	Rel. Vol. in com- bination	Change of Volume	Heat of Formation
1.	Pb	18.17	17.42	-0.75	+ 18500 = 120 × 0.75 × 206
2-3.	Pb	18.17	19.39	+1.22	- 30200 = 120 × 1.22 × 206
4.	Pb	18.17	19.81	+1.64	- 40607 = 120 × 1.64 × 206
5-7.	Sb	17.91	21.29	+3.375	- 48200 = 120 × 3.375 × 119
8-9.	Zn	9.62	11.53	+1.91	- 14900 = 120 × 1.91 × 65
10.	Zn	9.62	12.6	+2.98	- 23223 = 120 × 2.98 × 65
11.	Cu	7.08	9.05	+1.97	- 14907 = 120 × 1.97 × 63
12.	Cu	7.08	9.74	+2.66	- 20083 = 120 × 2.66 × 63
13.	As	15.69	19.58	+3.89	- 35000 = 120 × 3.89 × 75
14.	Mo	11.11	15.53	+4.42	- 50900 = 120 × 4.42 × 96
15.	Hg	14.65	17.05	+2.4	- 57400 = 120 × 2.4 × 199
16.	Hg	14.65	16.62	+1.97	- 47000 = 120 × 1.97 × 199
17.	Bi	21.29	24.29	+3.0	- 75200 = 120 × 3.0 × 209
18-19.	Na	23.7	11.85	-11.85	+ 32706 = 120 × 11.85 × 23
20-22.	Fe	6.95	11.65	+4.7	- 31570 = 120 × 4.7 × 56
21.	Fe	6.95	10.08	+3.125	- 21000 = 120 × 3.125 × 56
23-24.	Sn	16.1	18.08	+1.98	- 28040 = 120 × 1.98 × 118
25.	Cd	12.83	14.57	+1.74	- 23200 = 120 × 1.74 × 111
26.	Cd	12.83	15.16	+2.33	- 31000 = 120 × 2.33 × 111
25.	Se	16.27	11.25	-5.02	+ 47045 = 120 × 5.02 × 78
27-28.	Cr	7.12	8.78	+1.66	- 10364 = 120 × 1.66 × 52
29-30.	Ca	25.66	12.24	-13.42	+ 64420 = 120 × 13.42 × 40
31-32.	Ca	25.66	13.25	-12.41	+ 59568 = 120 × 12.41 × 40
33.	Ca	25.66	14.33	-11.33	+ 54376 = 120 × 11.33 × 40
34.	Ni	6.72	8.13	+1.41	- 10000 = 120 × 1.41 × 59
35.	Co	6.8	11.45	+4.65	- 32920 = 120 × 4.65 × 59
36-37.	Ag	10.1	13.61	+3.51	- 15080 = 120 × 3.51 × 107
37.	Ag	10.1	10.25	+0.15	- 1900 = 120 × 0.15 × 107
38.	Ce	21.12	19.20	-1.92	+ 32299 = 120 × 1.92 × 140
39	Si	11.59	18.91	+7.32	- 24600 = 120 × 7.32 × 28
40.	W	10.17	12.89	+2.72	- 60060 = 120 × 2.72 × 184
41.	Ta	17.928	21.98	+4.052	- 88500 = 120 × 4.052 × 182
42.	Th	21.49	13.62	-7.87	+219000 = 120 × 7.87 × 232

TABLE IV.

		Original Relative Volume	Theor. S.G.	Observed S.G. & Observer.	
1-4.	Pb	18.17	11.34	11.33 Kupffer	11.346 Crichton
5-7.	Sb	17.91	6.65	6.646 P & J	6.675 Spring
8-10.	Zn	9.62	6.76	6.512 P & J	6.939 P & J
11-12.	Cu	7.08	8.89	8.895 Hatchett	
13.	As	15.69	4.78	4.71 Bettendorff	4.91 Spring
14.	Mo	11.11	8.64	8.636 Bucholz	9.01 CK
15-16.	Hg	14.65	13.584	13.584 16°-6 Stewart	
17.	Bi	21.29	9.82	9.82 Roberts & Wrightson	
18-19.	Na	23.7	0.97	0.97 Troost & Hautefeuille	
20-22.	Fe	6.95	8.06	8.007 10° Schiff (reduced by H)	
				8.139 15°-5 Smith (electrolytic)	
23-24.	Sn	16.1	7.34	7.3395 Baudrimont	
25-26.	Cd	12.83	8.655	8.655 11° Matthiessen	
25.	Se	16.27	4.8	4.8 Rathke	
27-28.	Cr	7.12	7.3	7.3 Bunsen	
29-33.	Ca	25.66	1.56	1.566 Matthiessen	1.55 Jobin
34.	Ni	6.72	8.78	8.713 Baumgarten	8.88 Arndtsen
35.	Co	6.8	8.68	8.558 Henry	8.71 Lampadius
36-37.	Ag	10.1	10.6	10.621 0° Quincke	10.575 Christomanos
38.	Ce	21.12	6.628	6.628 Hillebrand & Norton	
39.	Si	11.59	2.416	2.337 Miller	2.48 m of 6 Playfair
40.	W	10.17	18.09	17.9 - 18.12 Bernouilli	
41.	Ta	17.928	10.15	10.08 - 10.78 Rose	
42.	Th	21.49	10.8	10.968 Nilson	

TABLE V.

	Rel. Volume.	Theor S.G.	Observed S.G. & Observer	
43. B ₂ O ₃	2(15.17)+3(2.51)	1.848	1.753-1.83 V N	
44. B ₂ S ₃	2(15.17)+3(15.53)	1.534	1.55 V N	
45. BBr ₃	15.17+3(27)	2.61	2.65 0°/4 V N	∴ 2.63 15°
46. LiCl	6.21+15.085	1.996	1.998 Kremers	
47. LiF	5.46+5.33	2.41	2.295 21° Clarke	2.54 C K
48. Li ₂ S	2(5.46)+15.53	1.74	1.63-1.7 V N	

TABLE VI.

	Theoretical Heat of Formation.	Observed H.F.	
43. B ₂ O ₃	-2(7800)+3(96155)	= 272865	272600
44. B ₂ S ₃	-2(7800)+3(30681)	= 76443	75800
45. BBr ₃	-7800+3(17000)	= 43200	43200
46. LiCl	38416+56132	= 94518	93900
47. LiF	42570+76820	= 119390	120000
48. Li ₂ S	2(42570)+30681	= 115821	115400

TABLE VII.

	Original Relative Volume	Rel. Vol. in com- bination	Change of Volume	Heat of Formation		
43-45. B	14.728	15.17	+0.892	- 7800	= 795 × 0.892	× 11
C	6.544	8	+1.456	-13886	= 795 × 1.456	× 12
O	10.07	7.53	-2.54	+32341	= 795 × 2.54	× 16
O	10.07	4.45	-5.62	+71515	= 795 × 5.62	× 16
O	10.07	2.51	-7.56	+96155	= 795 × 7.56	× 16
46. Li	13.11	6.21	-6.9	+38416	= 795 × 6.9	× 7
47-48. Li	13.11	5.46	-7.65	+42570	= 795 × 7.65	× 7
F	10.38	5.33	-5.05	+76820	= 795 × 5.05	× 19

TABLE VIII.

	Orig. Rel. Vol.	Theor S.G.	Observed S.G. & Observer.	
43-45 B	14.278	0.77	?	
C	6.544	1.834	1.84 Griffith	1.80 Playfair (charcoal)
46-48 Li	12.1	0.578	0.578 Bunsen	

Lithium is not quite in accordance, unless its S.G. is 0.534, which gives rel. vol. 13.11.

Stubbington House, Farnham, Hants.

ALUMINA.

HYDROLYSIS OF ALUMINUM SALTS.

*By Wilder D. Bancroft.**(From the Journal of Physical Chemistry, June, 1922.)**(Continued from Page 86.)*

Very recently Tingle¹ has claimed that alumina is not adsorbed by cellulose either from aluminium sulphate or basic aluminium sulphate solution. The first statement is not new, and the second is probably not correct as a general one, though it may be true for the particular experimental conditions. There is nothing to show that Tingle appreciated the necessity of having peptized alumina in his solution or that he did have it.

Aluminum acetate is usually used for mordanting cotton both in dyeing and printing. "The most common, and we believe the best method of using alumina as a mordant for cotton, is by substituting acetic acid for sulphuric acid in combination with it. The acetate of alumina has several advantages over the sulphate: 1st, the acetic acid is not so hurtful in its action upon the vegetable colouring matters; 2nd, it holds the alumina with much less force than sulphuric acid, and consequently yields it much more freely to the cloth; and 3rd, being volatile, a great portion of the acid flies off during the process of drying. When strong colours are wanted, and the mordant is of such a nature as will admit of being dried, it is better to dry the cloth from the mordant previous to dyeing. This last property of acetic acid is, therefore, very convenient, as it frees the cloth from any superfluous acid which may have been in the mordant; besides, it has been found that during the drying by heat, the soluble acetate is converted into a less soluble subacetate. We may here put the dyer in mind that when goods containing volatile acids are drying, no other kind of goods should be allowed to be in the same apartment, as the acid will be absorbed by them, and will affect almost any colour that either has been or may be put upon them. Many unpleasant and also expensive consequences occur from the neglect of these precautions."

Bancroft¹ gives an interesting account of the early use of aluminum acetate in calico printing. "By thus substituting the acetic for the sulphuric acid, in the aluminous mordant lately described, several considerable advantages are gained. The acetate of alumina being much more soluble in water than common alum, the liquor will contain a much larger proportion of alumine than could be otherwise suspended in it; and with this advantage, moreover, that it will not be liable to form crystals in or upon the linens or cottons in drying, as would happen with a solution of common alum, the acetate of alumina being incapable of crystallisation. I may add also that the acid of vinegar being volatile, and having a much weaker attraction for its earthy basis than the sulphuric acid has, the former will be speedily separated and carried off, especially by the heat of the stoves employed for drying the pieces printed with it, and will leave behind the alumine which it has dissolved, and which, being no longer encumbered by any other attraction, will yield itself wholly to that, which subsists between it, and the fibres of linen or cotton, and will unite with them more copiously and firmly than it otherwise could do, and be thereby enabled more strongly to attract and fix the colouring matters in the dyeing vessel. This, however, will only prove true, so far as the sulphate of alumina has been really decomposed by the acetate of lead, or so far as the alumina has been combined with the acetic instead of the sulphuric acid.

"As the practice of calico-printing has been but lately introduced into Europe, and as the acetic aluminous mordant does not appear to have been previously known in any other country, we might have expected that its discovery in this would have been deemed a matter so important as to have constituted an area in the history of art; and, therefore, I was not a little surprised in finding that no writer had mentioned, and that no calico-printer, of whom I have inquired, could inform me, at what time, or by whom, this mordant was first employed, as the basis of red and yellow colours in calico-printing. My wonder has, however, ceased on this subject, since I have inspected a considerable number of recipes for making the several mix-

1 *Jour. Ind. Eng. Chem.*, 14, 198 (1922).

2 Napier: "A Manual of Dyeing," 121 (1875).

1 "Philosophy of Permanent Colours," 1, 365 (1813).

tures employed as mordants, soon after the business of calico-printing began to be carried on with some degree of success here, and in other parts of Europe. In one of these, which seems to have been the earliest, alum, sal ammoniac, saltpetre, red orpiment, and kelp, were directed to be mixed with water. In another, which probably followed this, it was directed that these ingredients should be dissolved in vinegar. In a succeeding recipe, a little sugar of lead was directed to be employed, but in a quantity too small to be of any considerable use; I mean one ounce of it for every pound of alum. Afterwards, the calico-printers, without any system or reasonable motive, appear in different instances to have added verdigrise, arsenic, corrosive sublimate, blue vitriol, litharge, and white lead. By stumbling upon the two last (which alone were of any use), it happened, where vinegar had been also employed, as it commonly was in some shape, that after a variety of decompositions and recompositions, some portion of acetate of alumina was formed, the good effects of which were experienced, though without any true knowledge of the ways and means by which they have been produced. By degrees, however, the printers seem to have increased the quantity of sugar of lead, and several of them to have suspected that many of the other ingredients usually employed for making their mordants were useless. Some of them, therefore, began to omit one, and some another of these ingredients, until at length all the useless ones were laid aside, though without the aid of any chemical reasoning on the subject, and without any one having ever suspected, as indeed few of them do at this day, that the lead which they continued to employ occasioned any decomposition of the alum, or that the mordant so produced did not really contain all the lead and other ingredients used to prepare it. Among the useless ingredients before mentioned, corrosive sublimate seems to have been retained the longest, since Mr. Wilson includes it in his recipe, which was published so lately as the year 1786.

"It is not wonderful, therefore, that no particular person or period has been noted, or remembered, as distinguishable for the first invention of the acetated aluminous mordant; since the sugar of lead, or other means of forming it, were at first used by

chance so sparingly, as to have scarcely produced any better effect than would have resulted from the mere solution of alum, and the alterations and improvements by which the mordant afterwards acquired its present form, I had almost said perfection, were made by such imperceptible gradations, and resulted so much from the random additions and omissions of different individuals (no one of whom seems to have been guided by anything approaching to a just theory), that neither the discovery nor any considerable step towards it, can properly be referred to any one person or period.

(To be Continued.)

NOTE ON THE INHIBITORY EFFECT OF URINE ON THE PRECIPITATION OF UREA BY NITRIC ACID.

By EMIL A. WERNER, M.A., Sc.D.

Normal urine contains a little more than 2 per cent. of urea, yet when mixed with an equal volume of colourless strong nitric acid there is no precipitation of urea nitrate, even after the mixture has been cooled to 0° C., or allowed to remain in the cold for twenty-four hours., , ,

A similar experiment made with an aqueous solution of urea gave the following result:—

(1) An equal volume of colourless nitric acid ($D=1.42$) was added to 10 cc. of a 2 per cent. aqueous solution of urea. The liquid was cooled under tap-water. Urea nitrate commenced to separate after about three minutes. After twenty minutes the precipitate, which had been collected and well washed with ether, was titrated with $N/10$ NaOH. The weight of urea precipitated as nitrate was 0.1182 gram., equal to 59.1 per cent. of the total present.

(2) From a 4 per cent. solution of urea, treated in this way, 0.292 gram. was precipitated as nitrate, equal to 73.73 per cent. of the total amount of urea present.

On the other hand, when 2 grams of urea were dissolved in 100 cc. of a sample of normal urine (which contained 2.01 per cent. of urea), the weight of urea precipitated as nitrate from 10 cc. of the solution was 0.18 gram., as the mean result of three experiments. This equals 44.8 per cent. of the total amount present. Compared with

the result of the preceding experiment, it will be seen that in the presence of urine the amount of urea precipitated as nitrate was nearly 29 per cent. less ($73.73-44.8=28.93$) than in the plain aqueous solution containing the same concentration of urea.

The following result goes to show that the colloidal matter present in urine is no doubt responsible for the effect. A 2 per cent. solution of urea, in which 0.5 per cent. of gelatine had been dissolved, was treated as in experiment (1), 28.5 per cent. of the urea was precipitated as nitrate, *i.e.*, $59.1-28.5=30.6$ per cent. less of the urea was precipitated than in the plain aqueous solution.

Considering the small proportion of colloidal matter which is believed to be present in urine, its inhibitory effect on the precipitation of urea nitrate is rather remarkable. The writer is not aware that attention has been previously drawn to this property of urine.

University Chemical Laboratory,
Trinity College, Dublin.

RUDOLPH MESSEL.

From the First Messel Memorial Lecture delivered at the Forty-first Annual Meeting of the Society of Chemical Industry at Glasgow, July 4th, 1922, by Professor Henry E. Armstrong, F.R.S..*

I first met him in my initial year of office as a Secretary of the Chemical Society in April, 1876, on the evening when Dr. Squire and he described and demonstrated the process they had developed of manufacturing sulphuric anhydride, already in operation at Silvertown. He was elected a Fellow of the Chemical Society that same evening. I was the only speaker to break the harmony of the meeting by suggesting that Nordhausen sulphuric acid was not a mere solution of the anhydride but mainly a definite acid, a compound of the anhydride with sulphuric acid, anhydrosulphuric acid, then unrecognised except by Schützenberger. I trod on Messel's heels with a paper on "Systematic Nomenclature"; this, too, shadows me to-day.

I was greatly attracted to him from the beginning, and we soon became fast, I may say affectionate, friends. Perhaps I surprised him by knowing the work he had

done as a student on strychnine and maleic acid: I would here emphasise the fact that he started his career as a chemist on the organic side. Moreover, I had been ahead of him in cultivating the acquaintance of sulphuric anhydride—on German soil—as it was the subject of my Ph.D. thesis, published in English in the *Proceedings of the Royal Society*, under Frankland's patronage, in May, 1870, under the modest title, "Contributions to the history of the acids of the sulphur series. I. On the action of Sulphuric Anhydride on several chlorine and sulphur compounds." This was my introduction to the Royal Society. A little later, in 1871, I made my first appearance, as an independent worker, at the Chemical Society, with a paper on the use of sulphuric chlorhydrol as a sulphonating agent. Messel was afterwards led to take an interest in this compound through preparing it for me.

I thus came under thionic fascination at an early stage of my career, and was fully prepared to appreciate Messel's work and its value, the more as I had worked alongside Graebe in Leipzig and Perkin was my fellow secretary. ●

Messel was born January 14, 1847, in Darmstadt. He died April 18, 1920, at his chambers in Victoria Street, London. He was of Jewish extraction, but professedly Lutheran.

To-day I will give only a brief survey of his history, sufficient to make clear his proclivities and the influences to which he was subject.

His father, Simon Messel, was not originally intended as his father's successor in the banking business, but was apprenticed to a Parisian maker of artistic furniture, which accorded more with his own taste for art. The interest of this fact lies in the indication of the source of the highly developed artistic tastes which most of his children evinced. Before he had completed his training in Paris, however, Simon Messel was recalled to Darmstadt to take the place assigned to his elder brother, who had journeyed to America and there disappeared from the sight of his relatives. In consequence of this change, Rudolph Messel's early years were spent in what for those days ranked as affluence, and his father was able to provide adequately for his education. He was the second of five children, of whom four were to make their homes in England; the fifth

acquired great distinction as an architect in Berlin.

He received his elementary training at Schmidt's Academy in his native city. Shortly after his father's death in 1859 he was sent to a Huguenot school at Friedrichsdorf in the Taunus, where he remained until early in 1863, that is to say, until he was fifteen years old. His early interest in science and his precocity are shown by the following reference he made to this period in his Presidential Address to this Society in New York in 1912:—

"In 1861, when I was at school at Friedrichsdorf, in Germany, my master, Philip Reis, invented the first telephone. I was present at its birth, and assisted Reis in making the mechanical parts of some of his instruments and also repeatedly in his experiments, Reis being at one end of the circuit, speaking or singing, I listening at the other, or *vice versa*."

While he was at school, the family circumstances had changed, and it was clear that Messel would have to be self-supporting at an early date. His intention, formed during the last years at school, was to become an engineer, either civil or mechanical. In January, 1863, he discussed his future course of action with an old friend of his father's, Heribert Rau, an author of some distinction, then living in Frankfort. Rau wrote to him a letter strongly advising against this choice of a profession, basing himself upon the fact that the demand for engineers already fell short of the supply, whilst the boy's religion would, he said, militate against his receiving a State appointment. If the boy were father to the man, as all accounts indicated that he was, Rau knew well the love of independence and self-reliance which were among his young friend's salient characteristics. After citing the reasons given above, he lays the greatest stress upon the fact that to become an engineer would entail many years of study, preceded by years of practical work at the bench, so that the day when he would be able to support himself must be far distant. He then gives the young Rudolph positive advice, which it is clear determined all his future. He bids him devote himself to the study of commerce, which, he said, would rapidly lead to independence, and to combine with this the study of Chemistry, Physics and Technology, and so become a manufacturer. Rau seems to have felt that to be-

come a manufacturer was a great falling away from grace for an ardent boy, because he goes at great length into the great future which lies before him, and "the noble examples of enlightened and well-spent lives which were to be found among the great manufacturers of the day. Finally, he advises Messel to move to Frankfort, to enter the business of some large merchant, to attend at the same time lectures in Chemistry, Physics and Technology, and after completing his apprenticeship, to travel to France, Belgium and England, the lands of factories and industry, to keep his eyes open for this or that article, the making of which was urgently needed, and to become himself a factory owner.

That Messel's whole course of action was influenced by this letter it is clear, not only from the fact that he kept it to the last amongst his rarest treasures, but that he followed the advice it contained, almost verbally.

In April, 1863, he became apprenticed to E. Lucius, in his wholesale drug, chemical and pharmaceutical factory in Frankfort, where, according to a letter from Lucius, he obtained a thorough knowledge of the business in all its branches. He remained in Frankfort until September, 1866. Although there is no definite evidence that he attended lectures at the same time or who his teachers were, there can be little doubt that in this respect also he followed the advice given him. In 1864 and 1865 he was a member of the "Physikalischer Verein," which was then and later a teaching institution; the teacher in chemistry was Prof. Rudolph Boettger and in Physics first Prof. Oppel and later Prof. Friedrich Kohlrausch.

On leaving Lucius, Messel entered the Federal Polytechnic in Zürich, where he followed the regular first year course. Among the subjects taken were organic and inorganic chemistry (taught by Städeler); technical experimental physics (taught by Bolley); mechanics, mineralogy, botany and technical drawing. Messel completed his year in Zürich. The following winter he spent at Heidelberg studying organic chemistry under Erlenmeyer. According to a letter from Bunsen, he worked with the utmost zeal on analytical subjects in the laboratory of that great teacher, then in his prime. Bunsen, who wrote two years later, especially mentions Messel's manual dexterity, which he says was

clearly shown in his later published researches on strychnine-oxyethylene compounds and sulphomaleic acid.

From Heidelberg, Messel moved in the spring of 1868 to Tübingen, where he finished his education. Here he spent a year attending the course of experimental physics of Prof. Reusch and courses in organic, inorganic and analytical chemistry by Prof. Strecker. From the spring of 1869 onward he appears to have been engaged in various inquiries under Strecker. A description of those referred to by Bunsen in the letter noted above formed the thesis he presented for his degree. Messel left Tübingen for England in April, 1870.

I believe he came to England originally to act as private assistant to Roscoe. During the short period he spent in Manchester, he worked both with Roscoe and Grace Calvert. The outbreak of the Franco-Prussian war, however, led to his recall to Germany. Owing to some physical defect, he did not serve in the army, but was relegated to the Ambulance Corps; he was wounded while on service. When recovered, he returned to England, where he remained during the rest of his life and ultimately became an Englishman. He entered the service of Dun, Squire and Co., at Stratford, as assistant to Dr. Squire, and here he became a thionist; but the virus was already in his veins.

In his Presidential Address, he tells of a conversation in the beginning of the 70's with his former teacher Strecker, of Tübingen—who was the first to discover the relationship of alizarin with anthracene—and Brüning, of Höchst, on the importance of fuming sulphuric acid in the synthetic alizarin industry, then rising into importance. To his question, how the acid should best be made, Strecker gave the prescient reply, "That is a problem for you to solve." A few experiments convinced him, he says, that given pure gases, the catalytic action of platinum was the rational solution of the problem. On April 8, 1875, a telegram came to him at the laboratory, from Squire, asking him to read up that night about Nordhausen acid, as it was wanted by an alizarin works. The response was Messelian and immediate: no reading was necessary. Next day he showed how simple a matter it was to marry sulphur dioxide with oxygen by means of platinum. However, Squire was conventional and thought that the decomposition of an acid sulphate would be a simpler method. Ex-

periments were made as requested, but eventually Messel was told "to try his dodge."

With Messel to try what he had once conceived as practicable was to succeed. He was there already; he had seen and he conquered forthwith. A patent was taken out by Squire in 1875, and the process was described at the Chemical Society early in 1876. Meanwhile, Squire had established as a new firm Squire, Chapman and Co., with Messel as factotum; he would have objected to my calling him chemical-engineer, as he had no belief in half-breeds, also he was an entire disbeliever in the attempt to bring the works into the laboratory.

The process was established at Silvertown, and in 1878 he succeeded Squire as manager of the works, which he only quitted in 1915, when his health gave way under the excessive strain of the times.

The paper Messel and Squire read at the Chemical Society was never published: even I cannot say why; probably because of patents; from a remark made by Messel, I gather that it was not sent in by Squire. The record of the meeting on April 20 in the *Chemical News* runs simply as follows:—

"The speaker (Messel), after giving a sketch of the history of the manufacture of sulphuric acid, described the process for preparing the anhydride. The vapour of ordinary sulphuric acid is passed through a white-hot platinum tube, whereby it is almost completely decomposed into water, oxygen and sulphurous anhydride: the mixed gases, after passing through a leaden worm to condense the greater portion of the water, are completely dehydrated in a leaden tower filled with coke, over which a stream of concentrated sulphuric acid is allowed to trickle. The dry mixture of oxygen and sulphurous anhydride is now passed through platinum tubes heated to low redness and containing fragments of platinum pumice, when the gases recombine to form sulphuric anhydride which is condensed in a series of Woulffe's bottles."

In early days, I was a frequent visitor at Silvertown, where Messel not only worked but also lived in the modest quarters of a small house attached to the works, until he removed to chambers in Ebury Street, and afterwards to Victoria Street. Characteris-

tic of the man throughout his career was his unpretentious, simple mode of life. I only knew him to be vain in one connection—as President of this Society; but he was very proud of the F.R.S., and not a few of us were proud of him as a colleague. Generous and ever thoughtful of others, unselfish to a degree, he had little thought for himself and a hatred of all display; the artist came out, first in his extreme devotion to his own art—for chemistry, technical chemistry in particular, is an art—then in his love of the company of artists and other bohemians: he was a great admirer and friend of Gilbert—of Gilbert and Sullivan fame—and a constant frequenter of the Savage Club; may I add, as a judge of quality in champagne; in *Weib und Gesang* he had no estate, though he was musical. Living among them, he knew his work-people and was in sympathy with them: hence his popularity and power.

One understood his success when one followed his work. A man of astounding vigour and full of feeling, he burnt the candle at both ends and all over its surface. That he lasted so long always surprised me. When about sixty he was overtaken by diabetes. He was everything—not only chemist, engineer and business man; he also took care to cultivate the social side of his life; he was the only manufacturer of my acquaintance who attended regularly at scientific gatherings and showed real interest in the proceedings. He was thorough in everything he did. Probably he did far too much himself, but he could not suffer fools gladly, though not often impatient outwardly and always considerate. He had no hobby outside his business and science. During many years, his one way of recuperating was a weekly visit to Brighton on Sundays. He went down by the early train, walked out to the Devil's Dyke, had lunch, and then returned to town, usually to spend the evening with friends. In those days he was a real walker, as I found when occasionally his joyful companion.

Those who knew him, especially in the early days, will remember his vigorous frame, his black hair and sparkling eyes, his smiling face, his hearty bass staccato laugh, his peculiar guttural accent. If his portrait were to be painted, I think we should ask the artist to depict just that smile alone, following Tenniel's living presentation of the Cheshire Cat up in the tree by its grin. We can fancy him to-day,

smiling at King Ruttan and his crowd and at me the executioner, chuckling at my use of the axe of criticism. He never mastered English properly, though he spoke it fluently. He was very fond of young people, many of whom rejoiced in his generosity. We who knew him all think of him as one of the most lovable men we have met. His outlook on life was always cheerful and optimistic, but he was a close observer and critic; always broad, clear and careful in his judgments but deliberate in forming them. The example he set in leaving his fortune to science is a remarkable one and best proof of his considerate outlook. Honest and sincere himself, he hated insincerity and all meanness of spirit. He combined in his person all the best of German good qualities, fired and softened by Jewish imagination.

Nordhausen or Fuming Oil of Vitriol was the only kind of sulphuric acid known to the early chemists. Even in comparatively recent times, not more than a hundred years ago, the manufacture of Vitriolic acid, by burning sulphur, was so imperfect a process that the old method, troublesome and crude as it was, still held its ground.

The production of the anhydride, by decomposition of a sulphate, appears to have been known in very early times, indeed up to the year 1736 the only way of preparing sulphuric acid was to evolve vapours of the anhydride by destructive distillation of a sulphate and to pass these into water.

When Messel and Squire began their work, Baron Stark, in Bohemia, was sole maker of the fuming acid, the process he used being substantially that of Basil Valentine, born 1394. A particular kind of Pyrite was weathered (oxidised) by exposure to the air. The copperas (ferrous sulphate) so formed was dissolved out and the solution concentrated. The sulphate crystals which separated were usually sold; the mother liquor, containing much ferric sulphate, was then evaporated to dryness and the residue slightly roasted, so as to dry it. The vitriol-stone, as it was called, so produced, was broken up and charged into small bottle-shaped retorts arranged in a gallery furnace, in such a way that they could be heated to a high temperature. Instead of receiving the vapours in water, as in making sulphuric acid, they were condensed in oil of vitriol, a small vessel containing the acid being luted to each retort.

The distillation lasted about 36 hours, and as the quantity put into each retort was small, the product was also small. The consumption of fuel was great, and much labour was involved in charging and discharging the retorts, many of which were broken. The process required great skill on the part of the workers. All attempts to manufacture the acid in larger apparatus appear to have ended in failure.

At the outset, when the attempt was made to produce the anhydride by passing the vapour of burning sulphur mixed with air over heated pumice coated with spongy platinum, the chief difficulty met with was in condensing the anhydride. As Messel and Squire remark—the manner in which sulphuric anhydride will evade condensation from a gaseous mixture is something quite marvellous. When pure gases were used, the condensation was easily effected; on this account, in the early days of the industry, when the value of the fuming acid was much greater than that of oil of vitriol, a suitable mixture of sulphur dioxide with oxygen was obtained by decomposing the latter. In their experiments referred to in the paper, a small platinum still about 4 inches in diameter was so arranged in a Hofmann Gas Furnace that it could conveniently be maintained very nearly at a white heat. Ordinary oil of vitriol was slowly fed into the still and kept strongly boiling; the vapour was almost completely decomposed, the condensed water containing but little acid. After the mixture of gases had been dried by means of sulphuric acid, it was passed over pumice stone prepared with platinum, enclosed in a large tube made of thick platinum foil, heated to a dull-red heat by the waste heat of the gas furnace. Little or no sulphur dioxide passed away when the heat was properly managed, the process was continuous and the condensation perfect. Nearly 70 parts of anhydride were obtained from 100 parts of white sulphuric acid, the theoretical amount being 80 or thereabout.

In the early days, the demand was limited by the requirements of the dyestuff industry, especially that of the madder colours. When the use of the fuming acid was introduced into the Cordite industry, in connection with the displacement nitration process, the demand became much greater. At the close of his industrial career, Messel was producing from 250 to 300 tons of Oleum per week, containing 20 per cent. of anhydride in admixture with sulphuric acid.

As experience was gained and the difficulty of condensing the anhydride was overcome, sulphur dioxide prepared by burning sulphur and ordinary air were used. In this case also exact proportions were at first adhered to. I remember Messel telling me that he was first led to use excess of air and therefore to abandon the use of special appliances for the supply of the gases in due proportion by having his attention called, by his workman-foreman, to the fact that the plant worked better when air was supplied in excess.

In early days, to reduce the cost of carriage, acid was sent abroad of 80 per cent. anhydride strength and diluted with "monohydrate." Where this was done I forget, but that this was his practice I know, as when I once asked him if he had any knowledge of the process of making sulphuric acid (H_2SO_4) by freezing it out from oil of vitriol, he told me that he had at one time so made it for the purpose stated above.

Over and over again he told me that he aimed at making vitriolic acid by his process as cheaply as by the chamber process, and I well remember the joy with which he told me that he had at last succeeded.

Messel's claim to distinction does not rest upon the discovery of a chemical process, but upon his initial success in building up from the foundation, unaided and almost alone, a novel industry of great importance and in having solved a variety of technical problems of extreme difficulty. His success was due not only to his great mechanical ability and clear understanding of the task before him, but particularly to his high moral standard and his absolute devotion to work.

"The strongest weapon one can see
In mortal hands is Constancy."

Doubtless, in later days, as we all do, he derived assistance from outside, but this was only when his primary work was accomplished and it became necessary largely to extend the plant. We have been accustomed to admire the systematic manner in which the German chemical works are conducted with the aid of a considerable staff of trained, disciplined workers: what always appealed to me was the fact that he, a German working under our English conditions, with scarcely any technical staff, was long far in advance of his countrymen. His success was due, in the

first place, to his thorough scientific training and to his scientific outlook but, to an exceptional degree, to his moral attitude towards his work. The lesson to be learnt from his life should be of no small value to us.—(*Journal of the Society of Chemical Industry*, August 15, 1922.)

A MAGNETIC PROOF AND A SELF-CHARGING ELECTROSCOPE.

By Major C. E. S. Phillips, O.B.E.*

A MAGNETIC PIVOT.

This device may take various forms, and is intended to provide a means of rapidly setting up a delicate pivot in the laboratory. In the first of two examples exhibited a steel knitting needle stood vertically with its lower end resting upon a plate of glass, while the upper end was supported (without touching) by a permanent magnet held in a clamp immediately above.

The magnet could be lowered till the needle was nearly lifted from the glass plate, and, since the upper end was free and the lower end only pressing upon its bearing point with an extremely small force, the friction of the system was reduced to a minimum. It was then shown that the needle was very free to rotate about its axis, and that when a short arm was attached radially to the centre of it, and the needle itself slightly inclined, a control was afforded by the fact of the arm always moving so as to place its mass centre as low as possible. Under these conditions, but with the needle held nearly vertically, a slight lateral movement of the baseplate gave rise to a large deflection of the radial arm—possibly a useful application as an optical lever.

The other exhibit was a small sewing needle standing vertically with its point resting lightly upon the surface of mercury, while its upper end was supported by a magnet as before. It was explained that a convenient form of the pivot is also obtained by placing the magnet above the

needle below with its point held against the convex surface of the glass. In this way large masses of magnetic material can be supported for rotational experiments in concave surface of a watch glass and a which it is required to eliminate friction as far as possible. Many other forms of the device will suggest themselves.

A SELF-CHARGING ELECTROSCOPE.

This electroscope was originally designed and used in 1910-11 for radioactive measurements, but was then found to have a serious defect. In 1911 Prof. Zeleny described an instrument working upon something the same plan, but both this and an improved form suggested in 1915 by Prof. Horton are not free from this same defect—viz., the occasional adhesion of the gold leaf to the charged surface with which it periodically comes into contact. In the original form of this electroscope the leaf moved intermittently against a carbon point, which was kept charged to a constant potential of -200 volts, while the leaf stem was connected to an earthed ionisation-chamber, so that with, say, radium present the leaf was continually charging up, and then periodically discharging by touching the carbon point. The number of kicks of the leaf per minute was, of course, dependent upon the extent of the ionisation in the chamber. In the electroscope exhibited the occasional "adhesion" of the leaf is prevented by coating the object touched by the leaf with a layer of fine carbon (arc lamp) powder. The powdered electrode may in fact be approached so closely to the leaf (or fine carbon filament suspended from a gold leaf hinge) that an almost imperceptible movement results which continues regularly and without appreciable adhesion. It was also explained that the arrangement has been made to give a sharp sound audible in a telephone at the instant the leaf or fibre strikes against the powdered electrode, and that this result is being utilised in the design of a recording electroscope. It is expected that the device will prove useful for the measurement of X-ray intensity, &c., and enable electroscopic observations to be made at a safe distance from the source of radiation.—(*Proceedings of the Physical Society of London*, Vol. XXXIV., Part V., August, 1922.)

NOTES FROM FOREIGN SOURCES.

RECENT ATTEMPTS TO SEPARATE ISOTOPES.

Abridged from the Journal de Chimie Physique, XIX., 4, 336.

(Continued from Page 90.)

As has already been pointed out, the separation of isotopes by ordinary fractional distillation, based upon a difference of vapour tensions, seems to hold out very small chances of success. On the other hand it is possible to make use of the difference between the rates of vapourisation of the isotopes which depends as directly as the rates of diffusion upon the mobility and thus the mass of the molecules. Very simple considerations lead to the inference that the number of molecules which escapes in a given time from unit area of a liquid (or returns to it) is proportional to the square root of the molecular weight. If, then, evaporation is brought about in a sufficiently rarefied atmosphere, so as to augment the mean free path, and if the vapourised molecules are eliminated by rapid condensation before molecular hits can direct them again towards the liquid, the light constituent of the vapourised and condensed part should be increased in quantity. However, this method can give satisfactory results only if an accumulation of the heavy molecules or atoms at the surface of separation of the two phases is avoided. Diffusion in the liquid state must be rapid enough to destroy the denser superficial layer which tends to form as fractionation proceeds.

The method of which we have just explained the principle was discussed in 1920 by Bronstead and v. Hevesy, who used it in their principal attempts to fractionate mercury. The apparatus in which evaporation and condensation were carried out was a flask or tube with double walls, in which a vacuum could be made, and from which the residual fraction and the evaporated and condensed fraction could be removed separately after the operation. The surface of the metal was at a distance of from 1 to 2 cm. from the bottom of the inner vessel, cooled exteriorly by means of liquid air. Three such pieces of apparatus were used, of capacities 300, 40 and 8 cc. Evaporation was generally carried on at a temperature of from 40 to 60°, which cor-

responds to a vapour tension of the order of 0.01 mm. of mercury and to a mean free path greater than the distance between the liquid surface and the cooled wall. In these conditions nearly all the molecules which left the liquid phase ought to condense on the cold wall before colliding with another molecule. The conditions of separation were less favourable in some experiments carried out at 120° (vapour tension 0.7 mm. of mercury, mean free path 0.15 mm. only), but even in this case the method was not useless.

2,704 cc. of carefully purified mercury were used. In the first series of fractionations the distillates were rejected and the successive residues were evaporated. The operations were continued till the 18th residue, amounting to 0.2 cc., was reached. The density of each fraction was determined by using pycnometers of 5 and 1.3 cc. capacity for the first residues, and a pycnometer of very small capacity made by drawing out both ends of a capillary tube, for the last fractions, the volumes of which were only a few cubic millimetres. The filling and weighing was carried out in such a way that the results were accurate to 0.0001 per cent. Each time the purity of the metal was controlled by subjecting it to several fractional distillations, followed by a density determination. The density of the mercury increased regularly from 1,000,000 (arbitrary value adopted for the pure ordinary metal) to 1,000,230 (density of the 18th residue). Thus the increase of density was about 0.025 per cent. In a second series of experiments the first distillate was taken and an attempt was made to increase the proportion of light isotopes by putting again into the apparatus after each fractionation the evaporated and condensed part. The density was then altered in the opposite direction, the value 0.999740 being reached at the 14th distillate (of volume 0.2 cc.). The variation was thus again 0.025 per cent. The difference of density of the two extreme fractions, 0.05 per cent., corresponds to a difference of about 0.1 in the combining weight of the mercury. According to the authors, this result was due to the partial separation of the isotopes of atomic weight 199 and 204.

The same method, without any essential modification, was applied by Bronstead and v. Hevesy to the separation of the isotopes of chlorine. The substance employed was a litre of aqueous hydrochloric acid 6.8

normal. Evaporation was carried out *in vacuo* at a temperature of -50° . The water vapour and hydrochloric acid condensed as before on the inner bottom of the flask or tube containing liquid air. Fractionation was continued till the distillate and the residual part were reduced to 100 cc. The hydrochloric acid of these last two fractions was converted into sodium chloride, and the combining weight of the chlorine contained in these salts was compared by two methods: (i) by determining the densities of their saturated aqueous solutions (at 20°); (ii) by measuring the E.M.F. of a cell made by solutions of the two isotopic salts, diluted so as to contain the same weight of NaCl per unit volume. The first method gave as result a difference of 0.024, and the second a difference of 0.021 in the combining weights of the two specimens of chlorine, which corresponds to a difference of about 0.06 per cent.

Thus, of the three recently employed methods—centrifugation, fractional diffusion, and evaporation, the two last have led to the partial decomposition of mercury, neon and chlorine. Moreover, three new methods have been suggested, and probably it will not be long before they are tested.

One of these methods depends upon the phenomenon of thermic diffusion. If two communicating vessels, kept at different temperatures, are fitted with a gaseous mixture, it will be found that when a stationary state is reached the heavier molecules preponderate in the cooler and the lighter molecules in the warmer vessel. This special diffusion, mentioned in 1911 by D. Enskog in a purely theoretical article, was subsequently studied by S. Chapman and F. W. Dootson, who suggested it as a method of separation for isotopes. According to the calculations of these authors and the conclusive experiments which they carried out with mixtures of hydrogen and carbon monoxide or sulphur dioxide, separation by thermic diffusion would be even quicker and easier to effect than ordinary diffusion. In an article appearing in March, 1920, W. D. Harkins announced his intention of applying the method to hydrogen and chlorine.

Certain incomplete chemical reactions between a gaseous phase and a solid or liquid phase might also lend to a partial separation of isotopes. Thus, according to Brinsted and v. Hevesy, chlorine could be fractionated by passing the highly rarefied

gas through a silver nozzle: the lighter molecules (Cl_{35})₂, moving more rapidly, would strike the walls of the nozzle more frequently than the molecules (Cl)₂, so that the ratio of $\text{Cl}_{35}:\text{Cl}$ would be greater in the silver chloride formed than in the initial gaseous phase. J. J. Thomson has suggested an analogous method of separation, based upon the absorption of gaseous HCl by an alkaline solution. According to his calculations, 179 of the initial gaseous

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volume must be absorbed in order to raise by 0.5 per cent. the density of the hydrochloric acid which escaped absorption.

Finally, T. R. Merton and H. Hartley have suggested a method of fractionation of chlorine based upon a difference of the wave lengths absorbed by the isotopes of this gas. If we suppose, in agreement with Aston, that normal chlorine contains 9 molecules of (Cl_{35})₂ and 6 molecules of Cl_{35}Cl to 1 molecule of (Cl)₂, a beam of white light which had passed through a layer of the gas would contain fewer wave lengths absorbed by the light molecules; if this filtered light was used to bring about the combination of chlorine and hydrogen by the photochemical method, molecules of HCl_{35} would be obtained chiefly, since the wave lengths which are active in a photochemical reaction are those which the reacting molecules absorb. Whatever may be the future of this ingenious method, it is interesting to note that even spectral properties, hitherto regarded as the least likely to reveal the complexity of an element, are regarded to-day as being possibly able, in certain cases, to be employed in the separation of isotopes.

[END.]

INSTITUTE OF CHEMISTRY.

THE PRESIDENT'S ADDRESS.

By A. Chaston Chapman, F.R.S., March 1st, 1922.

I desire, in the first place, to offer you my thanks for the honour which you conferred upon me a year ago in electing me your President. While I very fully appreciate that honour, I also am keenly conscious of the obligations which the position carries with it, and of the great responsibility involved in the occupancy of a chair

in which I have been preceded by so many very distinguished chemists. I can only repeat the assurance which I gave you on the day of my election, that the best that I have to give is at all times freely at the call of the Institute, and express the earnest hope that, during my period of office, the usefulness of the Institute in the service of the profession of chemistry may increase, and that the high traditions associated with this chair may not suffer any diminution in my hands.

Owing to a variety of causes—foremost among which must be placed the intensive educational effect of the great war—the importance of chemistry to the national well-being is daily becoming more widely and more clearly recognised, and with that recognition has come a great development of the work of our Institute. A glance at the Report of the Council will suffice to show how numerous and how varied have been the problems calling for consideration and solution, and with one or two of these I should like, with your permission, to deal very briefly.

Before doing so, however, it is my melancholy duty to refer to the death of a number of our colleagues who were bound to us by close personal, as well as by professional, ties. Our losses during the past year have, I regret to say, been exceptionally severe, and include the names of men who have been prominent exponents of our science and who have contributed very materially to its advancement. The list includes the names of 30 Fellows, of whom no less than ten had served on the Council, seven Associates, and one Student. Although Dr. Odling's name appears in the list, a very sympathetic reference to his death was made by Sir Herbert Jackson in his address last year, and I need now perhaps only remind you that Dr. Odling was one of the petitioners for our Charter, and that he was President when that Charter was granted.

The death of Sir Charles Cameron, at the ripe age of ninety-one, removes from our midst a notable figure in the domain of public-health science, and an attractive personality. Sir Charles was elected a Fellow of the Institute in the year following its foundation, was a past Vice-President, and one of the signatories to the petition for a Charter.

In the death of Professor Edmund James Mills we have to deplore the loss of a very distinguished chemist who was an original Fellow of the Institute, and who filled at various times the offices of Councillor, Vice-President and Examiner.

By the death of Dr. Wynter Blyth, a Past Member of Council, sanitary science, and the chemistry of food and drugs, both sustain a severe loss.

In Edward Bevan, a Past Vice-President and Censor of the Institute, and a Past President of the Society of Public Analysts, professional chemistry has lost a prominent practitioner, and the Institute an active and loyal supporter. Possessed in an unusual measure of personal qualities which endeared him to those with whom he came into contact, his death will be felt by many of us as a severe personal loss.

In mentioning the names of Blount, Cassal, Hughes and Le Sueur, all of whom rendered the Institute good service in various capacities, I have, as in the case of Bevan, the sad duty of recording the passing away of old personal friends as well as of colleagues, who at one time or another have filled a not inconsiderable space in my professional life. Many who may read this address will understand and share my sorrow.

John Spiller's death, at the age of 88, will also bring to many of us a deep sense of personal loss. A former Member of Council, a firm friend of the Institute, and, notwithstanding his advanced age, a regular attendant at our annual meetings, his death not only severs a link with the past, but leaves a gap which will not be easily filled.

Of those who have not held office, we keep in grateful memory the name of W. J. Chrystal, and I would also like to refer to Walter Macfarlane, to whose able teaching metallurgical chemistry owes so much, and to Isaac Searf, whose memory will be dear to very many past pupils of the City of London School.

I would that I might refer more adequately to the services to our science rendered by many of those who have passed from our midst during the year, but this is unfortunately not possible within the limits necessarily assigned to a Presidential Address.

Notwithstanding our losses during the year, you will see from the figures given in the Report of the Council that our membership shows an increase of no less than 371, in addition to 81 registered Students. The organisation of our profession is thus being steadily effected by the incorporation within our ranks of those who are trained and examined, in accordance with the provisions of our Regulations. As one who entered the Institute by the iron gate of examination—to employ a phrase used by Professor Percy Frankland, himself an examined President—I would like to express my conviction of the wisdom of the action of the Councils under our immediate Past Presidents—Sir James Dobbie and Sir Herbert Jackson—in connection with the modification of our Regulations. The policy underlying that action was one for which I had long been an advocate, and in the light of our experience, I am confident that we shall have no cause to regret the step we have taken. The loyalty and unselfishness of our older Members has been beyond praise, and they have now the satisfaction of seeing the Institute based upon a sure foundation, and its position, as the body truly representing professional chemistry in this country, acknowledged alike by chemists, by the general public, and by the Government. To the professors and teachers in the universities and colleges we confidently appeal, to encourage the enrolment of duly qualified honours graduates, and we feel assured that the local sections will use their utmost endeavours to bring into our ranks the qualified chemists in their respective districts. In this way we shall continue to grow in influence and power, and our profession will, as a consequence, continue to maintain that high position to which it is entitled, from whatever point of view regarded.

You will see from the second section of the Report that the Institute, through its representatives, has taken part in the work of several public and quasi-public bodies, and has been called upon to assist the Government in various matters. Our thanks are accorded to our representatives for their services.

Our Honorary Treasurer has already dealt very fully with the financial position, and to him we owe our gratitude. That our finances are in a sound and satisfactory condition at a time when many similar pro-

fessional bodies are suffering more or less severely as the result of industrial depression and monetary stringency, is due in no small measure to the foresight which Mr. Voelcker has shown, and to the skill and unceasing care which he has devoted to the duties of his office.

The Benevolent Fund is making progress, and I am sure that our Treasurer would wish me to support his appeal for subscriptions. We naturally welcome the larger donations from those who are able to afford them, but what I would like especially to emphasise is the importance of receiving some contribution, however small, from all our Fellows and Associates, so that a substantial income may be assured. The existence of a profession ought to mean something more than a community of interests and occupation, and we should regard it as a privilege as well as a duty to help those of our brethren who, through no fault of their own, are in temporary difficulties, or have, perhaps, fallen by the way.

Under the new arrangement, introduced by the Council in March last, two of our Committees, the General Purposes, and the Nominations, Examinations and Institutions, now consist of the whole Council. For these Committees it is essential that there should be good attendances, and this arrangement has been found to work very satisfactorily. Under it every Member of the Council is afforded the opportunity of considering matters of general policy which come before the first-named Committee, and of examining in detail the various applications which are submitted to the second. The Report fairly summarises the work of the Council during the year, and I am sure that you would not wish me, nor should I desire to attempt, to supply a commentary on every section. There are, however, one or two of the more important matters with which it deals on which I would like to be allowed to make a few remarks. As you are aware, the Board of Education approached the Council in May last with the object of inviting the co-operation of the Institute in connection with a new scheme designed to encourage day and evening students in technical schools to follow properly graded and balanced grouped courses of instruction in chemistry and allied subjects. The main idea underlying the invitation was that schemes of training evolved by the various schools should be subject to the approval.

not only of the Board of Education, but also of the Institute, and that the local certificates hitherto awarded to successful students, and which often had little more than local value, should be replaced by national certificates issued by the Board and bearing the imprimatur of the Institute. Whilst it was obvious that any scheme intended to raise the level of general scientific, and especially of chemical, training in our technical schools could only have our warmest sympathy, it was also clear that the proposals needed the most careful consideration in order that any action we might take should not operate to the detriment of our own Fellows and Associates.

(To be continued.)

GENERAL NOTES.

THE DYE-MAKING INDUSTRY.

Professor Henry E. Armstrong, writing in the current *Manchester Guardian Commercial* on the position of dye-making in this country, has some pungent comments on what he describes as our lack of insight and imagination. "What we have first to do," he says, "is to overcome the conceit of the commercial mind—to disabuse it of the idea that it is competent to exercise undivided control. Before you can sell you must make; the maker is at least as worthy as the seller. We have a sufficiently good example in the co-operative work of the late Dr. Mond and Sir John Brunner, both of whom I knew intimately. Mond made what Brunner sold, but neither was of use without the other. The British Dyesuffs Corporation has never had a proper hub, never sound spokes to its wheel; little wonder that it has never constructed a real rim upon which it can run. Yet we know so well how this might be done. Speaking proof is before us in British Alizarin Company and Scottish Dyes, Ltd. The dyestuff industry is not merely concerned with the production of dyestuffs; it is creative of colour, and love of colour must be behind it. Perkin was greatly aided by Pullar, of Perth, and he was himself an artist in several fields. His would-be successors seem to have had no love of colour, to have been just dull drones. Herein our English industry has been greatly lacking—it has neglected the dyeing side; and our dyers, too have been so spoon-fed by the German firms, they have so relied upon them for instruction and even for assistance in matching colours, that they are now but ill-prepared to face

alone the difficulties dyeing presents. The Germans owe their great success in no small measure to the great attention they have paid to the application of the dyestuffs they have produced. Our position to-day is one of 'plenty brains, no money'; and as we persist in keeping the brains out of action there is little chance of our gaining money. We have no conception of ignorance; if we had, those who have presumed to take charge would from the outset have realised that they have not the necessary knowledge and experience."

RUST PREVENTION ASSOCIATION.

More than 30 firms have now intimated their intention of participating in the establishment of an Association of Manufacturers of Non-Corrodible Products. Those firms in doubt as to whether their work comes within the province of the new Association, will find useful the following definitions of such products:

(1) Articles or materials liable to rusting, corroding, or decaying influences; which, for economic or technical reasons, are constructed, or partly constructed, of vulnerable substances; and are rendered impervious by special processes.

(2) Corrosive or decaying agents rendered dimpotent by special processes.

(3) Plant and materials for carrying out special processes for the purposes indicated in (1) and (2) above.

(4) Plant and materials for the removal of existing corroded or decayed matter, or rust.

All established firms manufacturing any such products, or operating any processes as indicated, are invited to apply for tickets to attend the preliminary meeting, as well as firms engaged in the sale of such products.

Firms engaged in the following manufactures have already intimated their intention to be represented:—

Electrolytically-proofed metals, acid-resisting chemical plant, boiler-scaling apparatus, anti-fouling compositions, anti-corrosive paints, galvanised iron, stone preservatives, lacquers, Japans, nickel alloys, stainless steel, rust eliminators, rustless ironware, boiler compositions.

It is desirable to state that the Royal Society of Arts is not promoting the new Association, and that all correspondence should be addressed to Mr. W. R. Douglas Shaw personally, care of The Royal Society of Arts, 18, John Street, Adelphi, London, W.C.2.



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs can be obtained gratuitously.

Latest Patent Applications.

- 20829—Anderson, E.B.—Process for obtaining new shades on acetyl silk and new dyestuffs for use therein. July 29.
 20241—Boehringer Sohn, C. H.—Method of preparing acetylene for anæsthetizing. July 24.
 20831—British Dyestuffs Corporation, Ltd.—Process for manufacture of dichlor fluorane. July 29.
 20623—Gield, S.—Treatment of sulphide ores and minerals. July 27.
 20192—Guggenheim Bros.—Manufacture of sodium nitrate. July 24.
 20684—Humphries, H. B. P.—Ammonia distillation. July 28.

Specifications Published This Week.

- 157281—Helbronner, A.—Method of and apparatus for the manufacture of sulphuric acid.
 158512—Elektrochemische Werke Ges.—Method for the production of sulphonated condensation products.
 161165—Goldsmidt, V. M.—Manufacture of magnesium chloride.
 182886—Dehn, F. B.—Process for the manufacture of insoluble condensation products from phenol and formaldehyde.
 182988—Brunskill, W. B.—Treatment for obviating the rusting or oxidation of iron or steel surfaces.
 183044—British Dyestuffs Corporation, Ltd.—Process for the manufacture of phthalimide.

Abstract Published This Week.

Extracting Lead.—Patent No. 181239.—Messrs. Chemical and Metallurgical Corporation, Ltd., of 791, Salisbury House, London Wall, London, have obtained a Patent for an adaption of acid-brine process of extracting lead described in their prior patent Specification 127641. It is applied to the extraction of lead from leady mattes such as mattes containing lead, copper, and zinc. The pulverized matte is treated with a hot, strong solution of a chloride, to which has been added hydrochloric acid, sulphuric acid, or an alkali bisulphate.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

City of Cardiff Education Committee.

THE TECHNICAL COLLEGE.
 Principal: CHARLES COLES, B.Sc. (Lond.).
 DEPARTMENT OF INDUSTRIAL CHEMISTRY.
 Head of Department: H. W. WEBB, M.Sc., F.I.C., F.C.S.
 SESSION 1922-23.
 (Commencing on Tuesday, 3rd October, 1922).

JOINT COURSE

(with University College of South Wales and Monmouthshire).

A COMPLETE COURSE in CHEMISTRY and Associated Subjects is provided for those wishing to become industrial chemists. The Course includes:—

Chemistry, Physics, Mathematics, Chemical Engineering, Utilisation of Steam and Electric Power, Cost Accounting, together with a specialised practical training in a branch of industrial chemistry chosen from the following:—

- (1) Fuel.
- (2) General Iron and Steel Manufacture.
- (3) Gas manufacture.
- (4) Foundry work.
- (5) Tin-plate manufacture.
- (6) Refractories and Cement.
- (7) Electro Chemistry.
- (8) Brewing.
- (9) Paper-making.

Examinations which are also catered for by the Course include:—

B.Sc. (Lond.) Ext.
 Associate Institute of Chemistry.
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A number of Part-Time Courses are also available to cover requirement of work's Chemist, and those of various public examinations.

For further particulars of Full-Time and Part-Time Courses, Entrance Examination, Scholarships, Fees, etc., apply to the Principal. Forms of application for admission to the Entrance Scholarship Examination, duly completed, must be received by the 18th September.

JOHN J. JACKSON,
 Director of Education,
 City Hall, Cardiff.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3255

A STUDY OF THE GLOW OF PHOSPHORUS.—PERIODIC LUMINOSITY AND ACTION OF INHIBITING SUBSTANCES.

By LORD RAYLEIGH, F.R.S.

(Reprinted by permission from the *Proceedings of the Royal Society, A. Vol. 99.*)

1. INTRODUCTION.

Many experimenters who have used cold phosphorus for the absorption of oxygen from air must have noticed the appearance of flickering clouds of luminosity when the action is nearly complete. These occur in the gas space and obviously represent a delayed action between the slight oxygen residue and the vapour of phosphorus.* This action has been discussed by Joubert,† who recognised it as due to the propagation of combustion in an explosive mixture. He obtained it in a more striking form by the slow leakage of air into an exhausted vessel containing phosphorus: his conclusion was that below a certain pressure, too small to measure, phosphorus vapour and oxygen became richer in oxygen by the inflow of the latter, the point was reached when combustion became possible and an explosion was propagated.

* In this paper I do not enter upon the question of whether the glow is due directly to oxidation of phosphorus, or of phosphorus trioxide. When, for brevity, the oxidation of phosphorus is referred to, this reservation should be understood.

† "Ecole Norm. Annales," vol. 3, 1874, p. 209.

From the point of view of kinetic theory it seemed very strange that phosphorus vapour should behave thus. Joubert's view of the facts would seem to imply that the reaction of a molecule of phosphorus with oxygen was not dependant solely on the character and energy of molecular collisions, but also on the absolute value of the interval of time between them. These theoretical difficulties, and also the fascination of the experiments themselves, led me to attempt a further investigation.

2. TRAVELLING PULSES OF LUMINOSITY. NEED FOR THE PRESENCE OF WATER.

The earlier attempts were directed to getting the effect in as striking a form as possible. The first experiment which gave results worthy of record was as follows: A horizontal glass tube 48 cm. long and 2 cm. diameter (fig. 1) was closed at the ends. Along the top side, at intervals of about 4 cm. a number of lateral openings were provided, to each of which was attached a long vertical capillary tube about 1 mm. in diameter, and 1 metre long. These tubes were open at the far end to the air of the room. Along the bottom of the main horizontal tube was a layer of phosphorus. This had been melted into position under a layer of water. After cooling, the water was poured off as far as possible. The lateral tubes were then attached as described. The phosphorus at first presented a uniform luminous surface where it glowed in contact with the contained air, but after a time when the oxygen began to approach exhaustion, a flickering appearance set in. This developed, as the action proceeded, into a very definite and distinctive form. At the side entrances air was diffusing into the nitrogen atmosphere, which contained phosphorus vapour. Luminous pulses were observed to spring into existence at

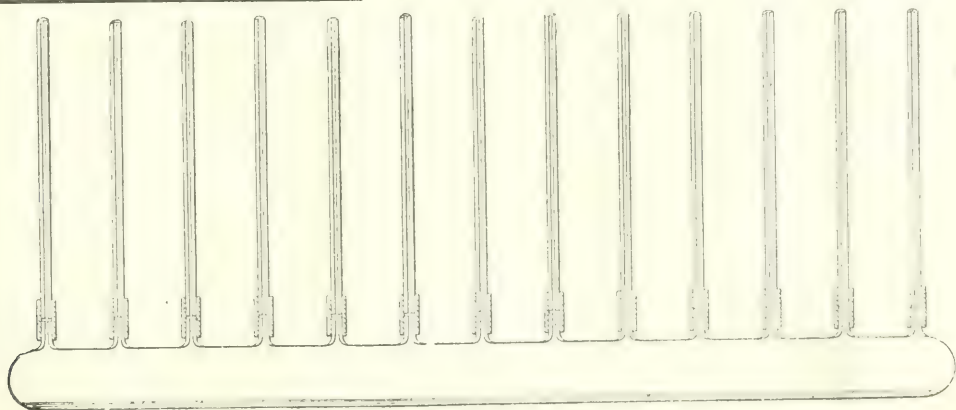


Fig. 1.

these side entrances, to divide, and to travel in opposite directions along the tube. The pulses were of the same diameter as the tube (2 cm.), and in thickness less than 1 cm. Their rate of travel was estimated at between 1 and 2 cm. per second. When two pulses originating at different places met one another, both were destroyed. It is easy to see why this should be the case. Suppose for distinctness of statement that the phosphorus vapour is in excess. Then each pulse as it passes leaves the space behind it exhausted of oxygen—its passage may be compared to the passage of an army living on the country, or a flight of locusts—no supplies are left in the rear. Another pulse meeting the first finds no oxygen to support its further advance or existence.

The arrangement of side entrances described was designed to provide, as far as possible, for a uniform admixture of phosphorus vapour and oxygen along the tube. On occasion a single pulse has been observed to traverse nearly the entire length. As a rule the pulses originated chiefly at two or three particular side junctions, perhaps owing to a favourable condition of the phosphorus surface for evaporation near these entrances; but the action was somewhat variable from day to day. A rise of the barometric pressure would cause oxygen to enter more rapidly than by diffusion, and a change of temperature also had some effect.

This apparatus continued to work well for a week or more, and was expected to do so almost indefinitely. But after a time it was noticed that the pulses were fewer and less brilliant, and that there were patches of stationary luminosity in the tube. After various possible explanations of the change had been examined, it was found to be due to the gradual drying of the phosphorus under the desiccating influence of the phosphorus pentoxide produced. On adding a few drops of water, the original condition was recovered.

For further examination of the effect of moisture, a tube was prepared, as in fig. 2, with a single side entrance, and a layer of phosphorus on the bottom. It was dried out by exhaustion on a mercury pump, with which a phosphorus pentoxide drying tube was connected. It was then filled up with commercial nitrogen (to save time), and the capillary entrance tube attached. There was now no trace whatever of the luminous travelling pulses. The glow, when air was entering, was perfectly steady, and took the form shown in fig. 2, *a*, *b*, *c*, which represent successive appearances as the air influx was gradually diminished. Any one of these stages could be maintained indefinitely.

On adding a few drops of water, a constant succession of travelling pulses was substituted for the steady luminosity (fig. 2, *d*). In this case a pulse, starting from where the oxygen was most concentrated,

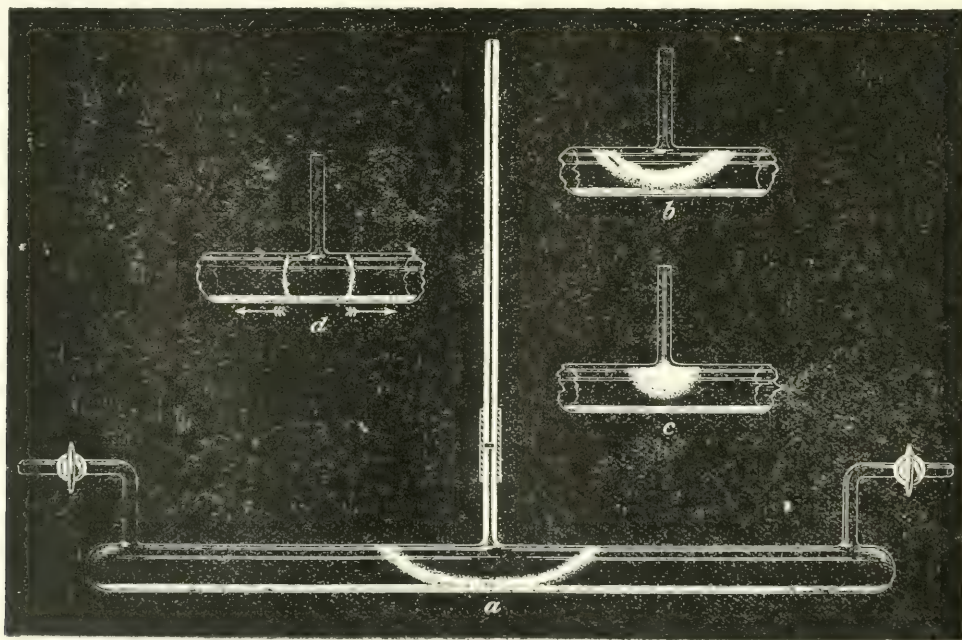


Fig. 2.

divided, and travelled in each direction into a region where the oxygen became progressively scarcer. Thus the pulse gradually lost in intensity, and became extinguished after travelling a distance of perhaps 6 cm.

It is quite clear, then, that in these experiments the presence of water vapour is an essential condition for the periodic luminosity.

The quantity of water vapour necessary was next studied. In this case a tall, narrow exhausted bottle was used, near the bottom of which was hung up a small piece of phosphorus—a slice cut from one of the ordinary commercial sticks. Air could be slowly admitted through a capillary tube, so as to raise the pressure a few millimetres per hour (fig. 3).

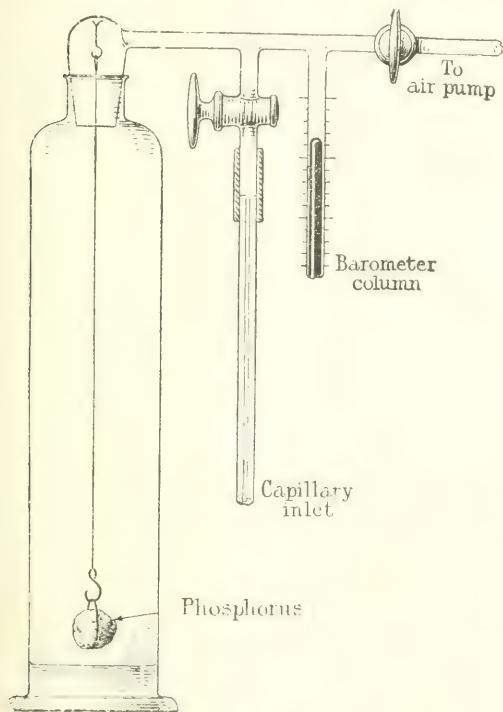


Fig. 3.

When the bottle contained a little water, intermittent luminous pulses travelled down it. Substituting strong sulphuric acid, the light at the top of the bottle, where air was diffusing into the phosphorus vapour, became quite steady. With acid of density 1.52 (vapour pressure 3 mm.), the flickering was much less conspicuous than with water only. Finally acid of density 1.66 (vapour pressure 0.8 mm.) was about the densest that would leave any perceptible unsteadiness in the light.

The saturation pressure of phosphorus vapour at ordinary temperatures is 0.025 mm. To get the intermittent luminosity will require a pressure of water vapour about 100 times as great.

It will be seen, then, that the quantity of water vapour required is of quite a different order of magnitude from that concerned in Baker's experiments.* He found that prolonged drying over phosphorus pentoxide would stop the action of oxygen on phosphorus altogether.

3. EXPERIMENTS WITH CAMPHOR.

The formation of luminous pulses evidently requires, as Joubert recognised, that combination between oxygen and phosphorus vapour should not occur until a certain concentration of oxygen is reached. At this point in the investigation it appeared clear that this restraining action was due to a peculiar action of water vapour. One could not fail to be reminded of the well-known action of ethylene, oil of turpentine, and numerous other substances, organic and inorganic, which are known to inhibit the oxidation and glow of phosphorus. Their action, it is true, is far more powerful than the action of water, but it seemed likely that the difference was only one of degree: if so, a judicious use of these substances would make it possible to get the travelling pulses in a much more striking form. This expectation was eventually confirmed. The earlier experiments made with ethylene and turpentine were not successful: I pass, therefore, to those made with the vapour of camphor:—

(1) A tubular bottle of 260 cc. capacity, about 15 cm. long and 4.5 cm. diameter, was used. At the bottom were placed a few pieces of phosphorus and a few pieces of camphor, about the size of peas.

No precaution was taken to keep the camphor and phosphorus separate, nor did this seem necessary.† The bottle was exhausted, and air allowed to leak in slowly through a capillary tube. The general arrangement was similar to that of fig. 3, though in the present case the phosphorus was not suspended. The air pressure rose at a rate of about 0.28 mm. per minute.

Five minutes after the evacuation, a brilliant pulse or flash of greenish yellow light was seen to pass down the bottle.

* *Phil. Trans.*, 1888, p. 581.

† Though an apparent charring of the camphor was noticed after some weeks.

Another similar flash passed after $1\frac{1}{2}$ minutes, and after that succeeded a series of flashes. The interval between them soon settled down to a pretty regular value of about 1 minute.

If the experiment is allowed to continue with the same rate of admission of air, nitrogen accumulates in the vessel and makes diffusion less easy. At a pressure of a few centimetres it is found that the luminosity which passes down lingers on the surface of the phosphorus for a second or two, and then for longer. Finally the phosphorus remains continuously aglow, and the pulses cease.

It is possible, however, to work in an atmosphere of nitrogen at atmospheric pressure. In this case the admission of oxygen must be slower to allow for the much longer time needed for the diffusion of phosphorus vapour away from the phosphorus surface.

The same bottle, with the phosphorus and camphor undisturbed, was filled to atmospheric pressure with nitrogen, and a capillary tube, 45 cm. long and 1 mm. diameter, attached to the neck, so as to allow of slow diffusion of atmospheric air into the bottle. This showed most striking effects. Thin and very bright pulses would start up and travel slowly along the length of the bottle. Sometimes they started in the middle, dividing into two, one of which travelled up and the other down. At other times a pulse would start from the top or from the bottom, and traverse the entire distance in one direction. These pulses were from 1 to 2 mm. thick (diameter 45 mm.) and travelled about 2 cm. per second. They contrast with the pulses observed in a rarified atmosphere (1 cm. pressure), which were 10 to 20 mm. thick, and travelled at a speed roughly estimated at 1 metre per second. The latter were much brighter, as is to be expected from the much shorter time they take to traverse the vessel, for the amount of phosphorus burnt in each case is not very different.

The thinness of the pulses at atmospheric pressure is due, no doubt, to the diminished facility of diffusion. Sometimes they were very flat, and accurately perpendicular to the axis of the cylinder in which they moved. At other times they had irregular curvature and were oblique to the direction of propagation. These differences are

doubtless to be attributed to irregularities of temperature in the vessel.

In the apparatus as described, the average interval between pulses was about 8 minutes, though its action was liable to temporary disturbance by changes in the barometric height. It has remained in good order for several weeks at the time of writing, and there is no apparent reason why it should not remain so for much longer.

Some other substances give very similar results to camphor. They were tried in the exhausted bottle only. A piece of filter-paper, moistened with the liquid, was placed at the bottom, and a piece of phosphorus hung just above (as in fig. 3). The substances found to behave thus were nitro benzene, butyl alcohol, amyl nitrite, and oil of bitter almonds—one drop only of the latter on filter paper. No doubt the list might be much extended. Ammonia may be added to it (see 6).

4. EXPERIMENTS WITH PEAR OIL.

A piece of filter paper was moistened with pear oil (consisting chiefly of amyl acetate), and placed at the bottom of a narrow bottle (height 18 cm., diameter 6 c.), with a slice of phosphorus hung just above it. The bottle was exhausted, and air allowed slowly to leak in through a capillary tube. At first the phenomena were similar to those observed with camphor, but at a pressure of about 5 cm. a change occurred, the luminous pulse starting not from the top, where the air was entering, but from the phosphorus surface. At the same time luminosity would cling to the phosphorus surface a second or two, after which it was extinguished. This tendency of the pulse to start from the phosphorus surface was repeatedly noticed in various experiments with pear oil under different conditions. Amyl alcohol gives the same effect. It is possible that camphor, or some of the other substances, which have been classified with it, might do the same if the right conditions were found. But they certainly do it less readily, if at all.

5. OIL OF TURPENTINE.

If a full quantity of this oil is placed in the bottle, luminosity is entirely stopped at all pressures up to the atmospheric. It was thought at first that a reduced quan-

tity would probably give the brilliant luminous pulses observed without camphor, but this did not prove to be the case. When only one drop was placed on filter paper, and introduced into the bottle, there was still enough vapour to inhibit the oxidation of phosphorus at low pressures.

The one drop may still have been enough to give saturated vapour. In order to reduce the effect, turpentine was dissolved in 100 times its volume of olive oil, or (in another experiment) in the same volume of medicinal paraffin. It was then found possible, with a very slow feed of air, to get periodic luminous waves, but they were of a different character from the comparatively thin and very bright pulses obtained with, *e.g.*, camphor. The head of the luminous wave was equally definite, but it left the whole track luminous behind it for a perceptible interval, after it had reached the bottom. All then became dark again.

These experiments seem to show that turpentine is not radically different in its inhibiting action from substances like camphor. The difference that there is cannot, however, be explained as merely due to a stronger action; for no concentration of turpentine, great or small, will give the effects as well as camphor.

The following oils, which were casually tried, seemed to behave like turpentine: aniseed, lavender, peppermint, eucalyptus, cinnamon.

(To be Continued.)

ALUMINA.

HYDROLYSIS OF ALUMINUM SALTS.

By Wilder D. Bancroft.

(From the Journal of Physical Chemistry, June, 1922.)

(Continued from Page 100.)

"Mr. Henry, justly sensible of the superior advantages of the acetated aluminous mordant in calico-printing, and conceiving it to have really been very anciently known and employed in those countries where the art was first practiced, concludes from thence, that it must have resulted from a very advanced state of chemical knowledge in those countries, at some very remote period, which was afterwards lost,

whilst the improvements arising from it in this respect continued to be practiced and handed down, through a long succession of ages to the present time. To have invented (says he) the process of printing, in the manner described by Pliny, the inhabitants of India must probably have known how to prepare alum; they must have been acquainted with the manner of dissolving lead in the vegetable acids; they must at least have been acquainted with the component parts of these salts, and they must have had a knowledge of double elective attractions, etc. In truth, however, the inhabitants of India neither had, nor have they at present, any knowledge of the use of sugar of lead, or of any other preparation of that metal which could produce similar effects in calico-printing; a solution of common alum in water being their only aluminous mordant, and the previous application of the soluble parts of myrobalans and of buffaloes' milk, to their calicoes, aided by a very hot sunshine, and the complete desiccation which it produces, enabling them, without anything like an acetate of alumina, to give equal durability to their colours. This fact I have learned, not only from all the accounts published or transmitted to Europe respecting this point, but from the positive verbal informations of eye-witnesses to the practice of calico-printing in that part of the world, and particularly of a gentleman of great veracity, as well as knowledge on this subject, who formerly carried on the business of calico-printing very extensively in Bengal (principally for account of the East-India Company): and indeed sugar of lead is so far from being used for this purpose there, that within a few weeks I have received a letter from Mr. John Adie (successor to the gentleman last mentioned) dated, "Gondelpara, near Chandernagore, the 10th of February, 1792," and mentioning that he had some little time before been obliged to pay twenty shillings the pound for sugar of lead, in order to prepare a particular colour which I had formerly recommended; so far was this ingredient from being in use there for any such purpose.

"We may, therefore, safely conclude, that the formation of an acetate of alumina, and its application as a mordant in calico-printing, was not an oriental discovery; and that it did not result from any knowledge of double elective attractions, or any other extensive chemical knowledge,

either in ancient or modern times; since those who gradually stumbled upon and introduced the use of it were totally ignorant of the decompositions and recompositions which took place in their mixtures, and always supposed, as all other calico-printers have till lately done, and as most of them do now, that the aluminous mordant really consisted of everything used in producing it."

We know that textiles are often made shower-proof by coating the fibres with some water-repellent hydrocarbon, wax or salt,¹ the aluminum salts being often used. We also know that the probability of electrostatic charges is greater the dryer the material we are studying. Both these facts were known empirically to Napier.² "Pieces (of cloth) mordanted with acetate of alumina and dried at a great heat, are highly charged with electricity. If the hand be suddenly drawn along the piece, a complete shower of fire is observed, with a sharp cracking noise, at the same time a prickling sensation is felt. Whether this has any effect upon the mordant, in its immediately combining with other substances, we do not know, but cloth in this state is very difficult to moisten—water runs off it as off a duck's wing; but we offer no explanation."

Liechti and Suida³ have made some experiments on the amount of alumina fixed by cotton from various solutions; but it is rather hard to tell from the abstract exactly what they did. "A weighed quantity of cotton was evenly impregnated with

say, an alum mordant until its weight was exactly doubled, and then hung in a dry place on glass rods for thirty-six hours. A certain portion was then incinerated in order to determine the amount of alumina which the fibre had at its command. Another portion of the prepared fibre was then dried in a constant air current for six hours at a temperature of 40° C. The fibre was then washed for six hours with a definite amount of distilled water, and the amount of alumina in it was carefully estimated. From the number obtained it was possible to determine the percentage of alumina which had become fixed on the fibre." This sounds perfectly simple; but the catch is in the phrase "evenly impregnated." The cotton was apparently steeped in the bath and then dried with the mother liquor in it. Since all the solutions had the same amount of alumina in them, an amount equivalent to 200 g $\text{Al}_2(\text{SO}_4)_3 \cdot 18 \text{H}_2\text{O}$ per litre, one would have supposed that the amount of alumina presented to the fibre would be approximately the same in each case. Actually it varies in a ratio of more than four to one. The data are given in Table II. In the first column is the hypothetical formula of the aluminum salt in solution. In the second column is the amount of alumina in grams presented to the fibres, an absolutely mysterious item. There is nothing to show to what weight of cotton it refers. In the third column is given the amount of alumina in grams fixed by the cotton, and in the fourth the percentage fixed. The apparent accuracy is, of course, absolutely fictitious.

TABLE II.
Adsorption of Alumina by Cotton.

Formula.	Al_2O_3 presented to the fibre.	Al_2O_3 fixed by the fibre.	Percentage Al_2O_3 fixed.
$\text{Al}_2(\text{SO}_4)_3$	0.6971	0.0901	12.92
$\text{Al}_2(\text{SO}_4)_2(\text{OH})_2$	0.4473	0.2283	51.04
$\text{Al}_2(\text{SO}_4)(\text{OH})_4$	0.1527	0.0897	58.74
$\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)_4$	0.5750	0.5190	90.26
$\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)_3(\text{OH})$	0.5012	0.5012	98.90
$\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)_2(\text{OH})_2$	0.1851	0.1851	91.19
$\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)(\text{OH})_3$	0.1987	0.1987	96.33
$\text{Al}_2(\text{CH}_3\text{CO}_2)_6$	0.2631	0.2631	51.27
$\text{Al}_2(\text{CH}_3\text{CO}_2)_4(\text{OH})_2$	0.2213	0.2213	99.46

1 Weber: *Jour. Soc. Dyers and Colourists*, 17, 146 (1901).

2 'A Manual of Dyeing,' 125 (1875).

3 *Jour. Soc. Chem. Ind.*, 2, 538 (1883).

From these data it is not permissible to draw the conclusion, which Liechti and Suida draw, that with aluminum sulphate the percentage of alumina fixed is greater the more basic the mordant. The percent-

age fixed varies with increasing basicity from 13 through 51 to 59; which is all that Liechti and Suida are considering. From what we know of adsorption, however, it is safe to say that the percentage adsorption would have been much greater than 51 if 0.15 g Al_2O_3 had been presented to the cotton instead of 0.45 g. The percentage adsorption for the hypothetical $\text{Al}_2(\text{SO}_4)_3(\text{OH})$ would have been less than 58 if 0.45 g Al_2O_3 had been presented to the fibre instead of 0.15 g. It is quite possible, therefore, that under comparable conditions the percentage of alumina fixed by the fibre would have passed through a maximum with increasing basicity just as it appears to do with the so-called sulphoacetates. On the other hand we do not know whether such a maximum, if found, would be real or would be due to the increased amount of sodium sulphate in the solution. In other words, although these experiments were made carefully, they are utterly worthless except as showing the errors which the next experimenter must avoid. Considering the time at which they were made, it is not surprising that the experiments are no better; but it is surprising that for nearly forty years they should have been considered as good work.

Kutschera and Utz, made some similar experiments, except that they hung the cloth, after drying, in the moist air at about 34° for forty-eight hours. They got a much more uniform mordanting of the cotton than Liechti and Suida did. One square decimetre of their cloth averaged seven grams in weight, and it seems probable, though not explicitly so stated, that this is the amount of cloth to which the figures in Table III. refer.

They confirm Liechti and Suida on the aluminum sulphate, and the basic aluminum sulphate. They are low (80 to 99) on the $\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)_4$ and also (87 to 99) on $\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)_3(\text{OH})$. The great apparent difference is with aluminum acetate where Kutschera and Utz get all the alumina fixed, while Liechti and Suida get only 51 per cent. fixed. The difference may not be a real one because Liechti and Suida get more alumina fixed by weight than do Kutschera and Utz; but they present to the fibre 263 mg. as against 145 mg. It is quite possible that all the loss in efficiency comes in at the higher concentrations. This argument cannot be used to cover the cases of $\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)_4$ and $\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)_3(\text{OH})$ because in both these experiments Liechti and Suida were getting higher percentages of alumina fixed with higher absolute amounts of alumina presented to the fibre.

Sodium aluminate is not used as a mordant in dyeing cotton; but it is padded on for calico printing.¹ There is no direct mordanting, and it is necessary to add ammonium chloride in order to precipitate the alumina. The use of aluminum formate² and of aluminum lactate³ has been advocated. Whether one uses an acetate, formate, or lactate does not affect the general theory of the process.

Matthews,⁴ who usually follows Ganswindt implicitly, breaks away from him on

TABLE III.

Adsorption of Alumina by Cotton.
100 cm² of cotton averaged 7 grams.

Formula.	Al_2O_3 presented to the fibre.	Al_2O_3 fixed by the fibre.	Percentage Al_2O_3 fixed.
$\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$	0.1566	0.0186	11.88
$\text{Al}_2(\text{SO}_4)_2(\text{CH}_3\text{CO}_2)_2$	0.1456	0.1462	100.43
$\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)_4$	0.1660	0.1324	79.76
$\text{Al}_2(\text{CH}_3\text{CO}_2)_6$	0.1446	0.1479	102.29
$\text{Al}_2(\text{SO}_4)_3(\text{OH})_3$	0.1350	0.0688	51.79
$\text{Al}_2(\text{SO}_4)(\text{CH}_3\text{CO}_2)_3(\text{OH})$	0.1495	0.1304	87.19

¹ *Mitt. techn. Gewerbe-Museums in Wien, Sektion für Färberei*, 3, 110 (1886).

¹ *Ganswindt: "Theorie und Praxis der modernen Färberei,"* II., 224 (1903).

² *Schwalbe: Zeit. Kolloidchemie*, 5, 129 (1907).

³ *Boehringer and Sons: Zeit. Farben-Ind.*, 9, 237, 253 (1910).

⁴ *"Application of Digestants,"* 602 (1920).

the question of mordanting cotton, and comes out fairly boldly for the formation of a metallo-organic compound. "In mordanting cotton the case is somewhat different, for the metals employed as mordants are usually in the form of basic salts, and the solutions of these, by great dilution, by long exposure to the air, or by warming, may become dissociated and there may be precipitated either the hydroxide of the metal or a strongly basic salt; for example, in mordanting cotton with acetate of aluminum a hydrate or basic acetate is formed. This, however, cannot be considered as "precipitation" in the chemical sense of the term. Although it may be shown that when cotton is steeped in a readily dissociated solution of aluminum acetate, a portion of the aluminum is withdrawn from the bath, it cannot be shown, however, that aluminum hydrate as such has been precipitated in the fibre. If such were the case, washing with lukewarm acetic or hydrochloric acid would remove all the hydroxide from the fibre again; but this does not happen, which is an indication that the aluminum must be fixed in some other form. A properly mordanted fibre requires that the metallic compound with which the fibre is mordanted must be held by this in such a form and with sufficient energy that the mordant cannot be removed by water or even by dilute acids or alkalies."

After two paragraphs on the mordanting of wool with copper, aluminum, chromium and iron, Matthews concludes that "all these facts appear to show that in mordanting with metallic salts the metal is combined with the fibre in the form of a metallo-organic compound, and the fibre, thus chemically changed, then possesses the proper affinity for dyeing with the mordant dyes." The fallacy lies in the assumption that an adsorbed substance will necessarily have the same properties as the same substance in mass. If that were really the case charcoal could not take soluble substances out of solution practically completely, and yet we know it does. If cotton takes alumina out of aluminum acetate, there is no reason why dilute acetic acid should take any appreciable amount of alumina out of cotton and still less out of wool, which holds the alumina much more strongly.

(To be Continued.)

QUERCITOL AND ITS DERIVATIVES.

By JOHN MISSENDEN.

Quercitol was first discovered as an essential component of the acorn, which is the fruit of the two growths, *quercus racemosa* and *quercus sessiliflora*, by Bracconot, who, in his first writings upon the compound,¹ described it as lactose. Further investigation by Dessaignes² showed that it had a distinct chemical formula, $C_6H_7(OH)_5$, and he named it after the Latin root of its mother-growth, giving it the alternative appellation of "*sucre de glands*."

It is a crystalline substance of the monoclinic-prismatic order, and is capable of rotating a ray of polarized light in a manner similar to the action of dextrose, thereby justifying Dessaignes' name of "acorn-sugar." The crystals are best prepared by treating an extract of acorn-juice with lead acetate, when the former will decompose. Certain colouring substances will be precipitated, together with tannin. The resulting filtrate should then be treated with yeast in order to rid it of such traces of glucose as may be present, and some other substance which will free it of lead. The remaining liquid should then be crystallised and recrystallised a number of times to rid it of impurities, hydrochloric acid being used as a solvent. The resultant crystals should have a fusion-point of between 224.6° and 225.2° C. Another method to produce quercitol is by the oxidation of quinone.

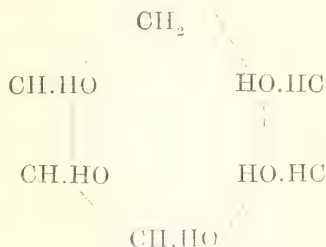
Application of heat at a temperature above 230° C. will bring about decomposition, quinhedrone, quinol, and other substances resulting; and treating quercitol with hydriodic acid under similar conditions produces, in addition to the two pre-mentioned bodies, phenol, iodophenol, and benzene. Hexane may be formed by heating the volatile iodides also produced, by the reaction with five times the quantity of hydriodic acid.

Quercitol is soluble in water in direct proportion to its temperature, but is totally insoluble in both ether and alcohol; be-

1 *Ann. Chim. Phys.* (3), xxvii., 392.

2 *Compt. Rend.*, xxxiii., 308; 462.

sides which, it possesses a 'sugary' taste. Its actual atomic constitution may be taken as follows:—



In addition to the sources already quoted Böttinger also found it in the leaves and more fragile structures of the *chamærops humilis* (fan-palm), and in the rind and superstructures of the acorn. A less abundant quantity has also been produced from the stalks of the *quercus sessiliflora*.

Some derivatives of quercitol are:—

Nitroquercitol (or *pentanitroxy quercitol*), $\text{C}_6\text{H}_7(\text{NO}_3)_5$, which may be obtained by mixing together nitric and sulphuric acids in their concentrated states. It is soluble in alcohol, but completely insoluble in water, and takes the form of a gelatinous mass.

Pentacetquercitol, $\text{C}_6\text{H}_7(\text{C}_2\text{H}_3\text{O})_5$, which is a bitter substance, very soluble in alcohol, and slightly soluble in water, with an amorphous form. It is best prepared by heating together a mixture of acetic anhydride and quercitol.

Pentaquercylchloride, $\text{C}_6\text{H}_7\text{Cl}_5$, which is an example of the five molecules of hydroxy being replaced by five of another substance—an acid radical. In this instance quercitol has been heated with hydrochloric acid with the production of a chloride, but similar reactions may take place with other acids, forming a corresponding salt. Pentaquercylchloride is crystalline, and has a fusion-point of 103.5°C .

A considerable number of ethereal salts may be produced by heating together fatty acids (or their anhydrides) with quercitol, but they are so varied and of so little importance as not to merit especial mention.

3 *Liebig's Ann.*, ccl., 269.

KUKKERSITE.

THE OILSHALE OF ESTHONIA.

By E. H. Cunningham Craig, B.A.,
F.R.S.E., F.G.S.

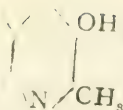
Kukkersite is the name given to the oil-shale of Esthonia, where it exists in a

simple form, and with the exception of torbanites, is one of the richest. It varies from grey to green in colour, later turning reddish brown, and has S.G. 1.2 to 1.4. The mineral portion of the shale has the composition, silica 32.74 per cent. or less, alumina 15.76 per cent. or less, iron oxide 1.68 per cent. or less, lime or calcite 49.64 per cent. or less, which, disregarding the lime, represents a fuller's earth. The volatile matter varies from 54 to 56 per cent., and the total organic contents are composed of C. 70.52 to 72.82; H. 7.20 to 8.66 per cent.; N. 0.3 to 0.68 per cent.; O. 21.98 to 16.24; S. up to 1.60 per cent. Distillation of the oil from the shale can be completed at 500°C . or under. A yield of 70 to 80 gallons of oil (S.G. 0.93) can be reckoned upon. Dr. Perkin showed at the meeting of the Institute of Petroleum Technologists a sample of the oil from a three hundredweight test in a horizontal gas retort, distilling up to 480°C . The yield was 55 gallons per ton, the oil having the characteristics: S.G. 15°C . 0.9292; B.Th.U. 16825; Hash point 63°F .; S. 0.51 per cent. On fractionation 0.5 per cent. of water was found; up to 170°C . 25.5 per cent.; $170^\circ\text{--}230^\circ\text{C}$. 15.0 per cent.; $230^\circ\text{--}360^\circ\text{C}$. 40.0 per cent.; Residue (thick tarry oil) 19.0 per cent.—(*Jour. Inst. Pet. Tech.*, Vol. 8, p. 349.)

A NEW TEST FOR CARBOHYDRATES.

O. BANDISCH AND H. J. DENEL.

The new test depends upon the formation of acetol, a ketone alcohol, when the simple carbohydrates are distilled with sodium bicarbonate. This compound is then detected by an appropriate test. The authors describe one test illustrating the method of using the method: 0.1 gm. of the sugar in 100 ccs. of water is treated with 5 gm. of sodium bicarbonate, is distilled to dryness, and the distillate collected. To this is added 30 mgms. of o-amino-benzaldehyde dissolved in a little alcohol, a small quantity of potassium hydrate solution and a piece of porous tile. The whole is evaporated to one-third its volume and acidified with HCl, and then made slightly alkaline with sodium bicarbonate. In the presence of a carbohydrate a bluish fluorescence will be seen, due to the condensation of the acetol with the o-amino-benzaldehyde to form 3-oxyquinal-

dine,  and 3-oxyquinoline

gives a fluorescence with sodium bicarbonate. Positive tests have been obtained with arabinose, xylose, ribose, lyxose, glucose, maltose, and dextrin, but not with starch. As a rule 0.1 to 0.2 gm. of the carbohydrate in 100 ccs. can be detected.—(*Journ. Amer. Chem. Soc.*).

INSTITUTE OF CHEMISTRY.

THE PRESIDENT'S ADDRESS.

By A. Chaston Chapman, F.R.S., March 1st, 1922.

(Continued from Page 111.)

An Advisory Committee of the Institute was appointed to confer with representatives of the Board, and the matter was very thoroughly discussed in all its bearings. As an outcome of this discussion arrangements were entered into with the Board for approving schemes of training and for conducting examinations for the award of the "national" certificates, to which I have referred. Not the least pleasing feature in connection with this matter is the recognition accorded by the Government to the Institute as the body best qualified to advise in connection with chemical training, and the implied public confidence in the Institute's imprimatur. Your Advisory Committee were especially careful to ensure that steps should be taken to prevent any possibility of confusion arising between the new "certificates" and the diplomas of the Institute. The working of the scheme, which is to be put into immediate operation, will be watched with interest by us all. It should possess the great advantage of bringing the students at an early stage of their career into touch with the Institute, and so tend to diminish the number of those "hard cases" in which Students have discovered too late that their training has not been such as to render them eligible for our Membership. I would like to emphasise the point that nothing is farther from the intention of the Council than to lower in any way the standard of the requirements for the Associateship; for

if there is one thing that must be clearer to us than another, it is that by the value of our diplomas we stand or fall.

I have intentionally given this question, bearing as it does upon the training of the chemist, an early and a prominent position among the matters to which I desire to refer. For so doing I need offer neither apology nor elaborate explanation. I submit that the training of the chemist—and by that I mean his general as well as his more technical education—is a matter of the deepest interest and importance to the Institute, to the profession which it represents, and to the nation at large. After all, a profession necessarily connotes that which is professed and the person who professes it, and in practice the two cannot be dissociated. I think I may say, without exaggeration, that the position of any profession in the public estimation is, in fact, even more dependent upon the general character of the men who follow it than upon its intrinsic importance. In any case the public are better able, as a rule, to judge of the former than of the latter.

In our own interest, therefore, and to take no higher platform, it is of the most vital importance that chemists as a body should possess educational qualifications, and, I would add, social qualities of no lower order than those which are associated with the members of the older professions, such as medicine or law. In an open and comparatively young profession, such as chemistry, it is obvious that not only should we endeavour to make clear to the public what we are, and in what our activities consist, but we ought to seek, by every means in our power, to ensure that we are represented by men possessing what we regard as adequate training and proper qualifications.

It may be asked how, in an open profession like our own, can this desirable end be attained? The answer is, that it is perhaps in the nature of an ideal; but just because our profession is an open one, it behoves us both in our corporate capacity, as Members of this Institute, and as individuals, to be especially careful so to bear ourselves that we shed lustre, or at least do not bring discredit on the profession of our choice. This brings me to a question which is ever present in our minds, and which has at various times occupied the attention of our Councils—I refer to the use of the designation "Chemist." I do

not believe that any single cause has contributed so greatly to the unsatisfactory position which professional chemistry has occupied in the past, in the esteem both of the Government and of the general public, as the misapplication—as we regard it—of the word “Chemist.” In no other country—so far as I am aware—is there any confusion between the person who practises chemistry, and the person who follows the profession of pharmacy, and continental chemists have often expressed to me their inability to understand what they no doubt regarded as one of our many national peculiarities. The restriction of the title “Chemist” to the person who follows the profession of chemistry is obviously desirable, and no one would welcome such restriction more warmly than I. At the same time, we have to consider not only what is desirable, but what is practicable, and to those who may not fully appreciate the difficulties and complications with which this question abounds, I would recommend the careful study of the statement which has appeared in the last issue of the *Journal*.

This statement has been approved by the Council as a clear presentment of the case, and it is to be submitted to the local sections, with a request that they will consider it and transmit their views and suggestions, in due course, to the Council.

The arguments in favour of the restriction of the title, as well as those in favour of the restriction of practice and compulsory registration, may, I think, be found on close examination to be of a double-edged character, and we must move with the greatest caution in any endeavour we may make to amend the present admittedly unsatisfactory state of affairs. For the moment we must, I think, be content to express the hope that our friends, the pharmacists, without relinquishing their rights, will, whenever possible, refer to their ancient, important and very honourable calling by the word which more accurately defines and describes it.

I have discussed the matter at various times with a number of pharmacists, the majority of whom have expressed themselves as being quite willing to adopt the more correct style, and there are not a few who have discontinued the use of the word “Chemist” in referring to their occupation. The power—I might even say, the tyranny—of a word is often very great, and I would appeal to the Press, as a very

important factor in the enlightenment of the general public, to assist, so far as they can—by employing the terms “chemist” and “pharmacist,” respectively in their correct significations.

Only a few weeks ago, I noticed that the displayed contents bill of a prominent London evening paper, which was devoted entirely to a reference to a case of alleged poisoning, contained in large type the words: “Chemist’s Evidence.” I at first thought that the evidence in question was that of the Home Office Analyst, but on turning to the columns dealing with the case, I found that it was that of a pharmacist from whom certain purchases had been made.

It is bad enough when mental confusion is the unfortunate consequence of the poverty of a language, but in this instance the correct and distinctive words are ready to our hand, and the confusion is entirely of our own making, and readily avoidable.

I would like to echo the wise advice given by Sir Herbert Jackson in one of his Presidential addresses, that we should do well to adopt, in describing ourselves, the plain title “Chemist,” and to omit as far as possible, such qualifying adjectives as “Consulting,” “Analytical,” “Research,” or “Agricultural.” This would not only indicate that we claim to possess that broad general training, without which specialisation is impossible or at least very dangerous, but it would also, I venture to think, be one very effective step towards making the public understand the proper meaning of the word.

Finally, it should be the business, I would even say the duty, of every properly qualified chemist to explain to all his friends and acquaintances the true nature of his calling, and to see that, so far as they, at least, are concerned, there is no room for misunderstanding.

I would even suggest that he should go further than this, and lose no opportunity of explaining and emphasising the great importance to the community of the profession of which he is a member.

The Institute of Chemistry and the various Chemical Societies are, in their corporate capacities, doing a great deal in this direction, but what is even more necessary is that every chemist should take a keen pride in his profession, and, realising his individual importance to the State, should constitute himself an active propagandist.

We are frequently told, and with a great deal of truth, that one reason why the profession of chemistry has not received that full degree of recognition to which it is entitled, is that the general public have only had a very vague conception of the nature of the chemist's activities.

We must not forget that, in this respect, chemistry is at a great disadvantage, as compared with medicine and the law, and I am convinced that proper and dignified methods directed to the education of the public would be productive of much good.

As I stated at the commencement of this address, the war proved a very powerful factor in that process of education, and the profession of chemistry occupies to-day in the public esteem a position such as I never thought possible in my life-time. At the same time, I cannot ignore certain indications that we are rather losing than gaining ground, and it behoves every one of us to help to the best of his ability to consolidate the position we have won, and to keep alive in the public mind the enormous national importance of the profession which we represent.

Whether we regard chemistry as a subject of study, essential to an understanding of the world in which we live, as an agent which has done so much to transform the life of man, as one of the most powerful factors in the creation of material wealth, or, finally, as that department of natural knowledge on which our national prosperity and our national security so largely depend, its supreme importance is equally manifest, and that importance it should be our business to make the public understand, and, having made them understand, to see to it that they are not allowed to forget.

To the young chemist, who is just on the threshold of his career, and who may think that what I have said chiefly concerns the older members of our profession and those who have made a position, I would say that he, also, is a representative of the profession, and, in that capacity, one of the guardians of its welfare.

I know something of the difficulties of our younger Members and of their hardships and disappointments, and I would like, with that knowledge and much sympathy, to point out to them that, no matter how humble the tasks entrusted to them, they should remember that it is the worker who confers dignity upon the work, and bear themselves in such a manner as to

compel respect, both for themselves and for the profession to which they belong. Everything must have a beginning, and if the profession which they have chosen is an exacting one, it has many compensations; perseverance and good and honest work will almost invariably bring their due reward.

It is a source of keen pleasure to me that it should have fallen to my lot to present the first medal with which the name of the Institute is directly associated. I refer, of course, to the Meldola medal, awarded for original chemical investigation of exceptional merit, and in memory of our Past President, Raphael Meldola.

This medal is the gift of the Maccabæans, a Society of which Meldola was also President, and which is associated with our Council in all matters relating to the award.

Many appreciations of Meldola's great services to Chemistry, and, indeed, to science in general, have been written, and it would, I feel, be out of place if I were to say more than that we remember with gratitude the good work he did for the Institute, and that we mourn in him the loss of a true friend and a very wise counsellor.

The Institute is fortunate in possessing the excellent portrait by Mr. Solomon J. Solomon, presented in 1917 by a number of Meldola's friends, and we welcome the further means now afforded us of honouring and perpetuating his memory.

In some respects, the award is, I believe, unique, for whilst it may be made for original investigation carried out in any branch of chemistry, it is intended primarily as a recognition of work of outstanding merit in the domain of Analytical Chemistry, a branch of our science which has not, I think, received in the past that degree of recognition which is its due.

The first recipient has, however, earned distinction by his work in Organic Chemistry, and I think it is perhaps due to him, in the circumstances above referred to, that I should say that the Board of Examiners and the Council were unanimous in their decision.

The medal, moreover, differs from many awards of a similar character in that it is restricted to British Chemists under thirty years of age, and is therefore intended to be a recognition of exceptional promise rather than of complete fulfilment, and I feel no hesitation in expressing the belief

that it will serve as a stimulus to our younger chemists, and will be regarded by them as a mark of high distinction.

Before passing on to another subject, I would like to take the opportunity of expressing our thanks to Dr. Spielmann for the great assistance which he, as the representative of the Maccabæans on the Adjudicating Board, has rendered us.

A matter which I regard as of very high importance, and which has occupied the attention of the Special Purposes Committee, is the home-production of laboratory glassware, porcelain and fine chemicals.

Having regard to the various interests concerned, and to the fact that some of these do not always run quite parallel, it is not perhaps surprising that different opinions on this subject should have been expressed. The view taken by the Council of the Institute, and by many others who are desirous of seeing these industries firmly established in this country, is that it would be a mistake of the first magnitude to allow ourselves again to be placed in that position of dependence on foreign—and possibly enemy—nations in which we found ourselves at the outbreak of war in 1914.

CINCHONA PLANTATION IN INDIA.

The last war has emphasised in a most emphatic manner the importance of adequate prophylactic treatment of malaria and has once more brought into prominence the vexed question as to the best derivative to thoroughly treat this disease and prevent its relapses. To realise the importance of this question, it is only necessary to remember that the greatest loss of effective man power particularly, of Eastern front, was due to malaria. To come nearer home, the toll of malaria every year in India, especially in Bengal, is appalling. One has only to go round the villages and witness for himself the devastations caused by this terrible scourge. Of all the measures of prophylaxis which have been tried so far, it may be said that none have proved a real success. Side by side with the prophylactic measures, treatment of cases of malaria is of equal importance, and the modern experiences of the *cinchona* has proved that in quinine, we

have the highest form of curative measure. Since the isolation of *quinine* from *cinchona* bark, it has been regarded as a specific for malaria to the exclusion of all other alkaloids, and even as long ago as 1866 a committee was appointed by the Government of India who, after careful deliberations, came to the conclusion that *cinchonine*, *cinchonidine* and *quinidine* possessed a marked curative effect. In spite of this, however, *quinine* is still considered to be the one specific for malaria. It was, however, through the effort of Sir David Prain and Sir Clements Markham that cultivation of *cinchona* in India was improved and expanded. We are now beginning to realise that besides quinine there are other alkaloids of *cinchona* which give an enhanced cure-rate if properly administered. The question therefore which confronts us at the present moment is how far *cinchona*, and as a matter of that, other alkaloids can be supplied from our own cultivation. About 13 kinds of *cinchona* are grown at the present moment in the Government plantations; of these *Cinchona succirubra* and *Cinchona Officialis* grow well and yield about 4½ per cent. of *quinine* and about an equal percentage of *quinidine*. The Government *cinchona* plantations manufacture *cinchona febrifuge* which contains several alkaloids. Unfortunately, however, the *cinchona febrifuge* that is produced in this country cannot supply the demands of India, and in addition to this the Government alone imports on an average about 51 thousand pounds of *quinine* from the United Kingdom mainly into Bengal. In the year 1904-5, 68,648 lbs., and in 1906-7, 71,737 lbs. were imported by the Government mainly into Bengal. These figures are rather significant and seem to show that a successful industry might be organised to meet the demands that create these imports.

Cinchona febrifuge is hardly ever used by the local practitioners for the treatment of malaria. Firstly because it is not always available in the market, and we are informed that the Presidency Jail has of late stopped its supply for some time. The other reason for not using this is because of the common prejudice that it is of less value than quinine and that *cinchonism* is more common than with *quinine*. Since this is a mixture of several alkaloids of *cinchona* bark and as it also contains *quinine*

and *quinidine*, it seems that it should be of greater value in treatment of malaria than *quinine* itself. These untoward effects are chiefly due to the alkaloid *cinchonine*, which causes more gastro-intestinal symptoms than any other alkaloid. It is possible therefore by a more careful manufacture, *cinchonine* content may be reduced and thus lessen the untoward effects. *Cinchona febrifuge* is cheaper than *quinine* preparations, and there is no reason why *cinchona febrifuge* should not be used on a larger scale, provided there is ample supply to meet the demand, when we know that in this we are assured of better results than either *quinine* or *quinidine* used by themselves.

At present the supply of *quinine* for the whole world is being done by the Dutch Government from their plantations in Java. It must, however, be remembered that in Java both the climate and soil are peculiarly favourable to cultivation of *cinchona* with a high percentage of *quinine*. Java will therefore always hold its own against India unless *cinchona* plantation is done in this country on a larger scale and on a commercial basis. It is therefore necessary that some experts well acquainted with the conditions of the soil and climate of the country suitable for *cinchona* plantation on a large scale, and chemists possessing the requisite knowledge of extraction of different alkaloids from the bark, and those who have the best knowledge of the action of these alkaloids on the human system, should investigate the question jointly and formulate such measures as will enable the country to produce sufficient *cinchona*, not only for its own needs, but also make a profitable trade by exporting the bark to foreign countries. India's demand for *quinine* is great and increasing, and it is a pity that with all the resources available, India has to depend upon Java for the supply of such a vitally important drug as *quinine*. At present there are about 18 *quinine* factories in the world—5 in France, 3 in England, 2 in Germany, 1 in Holland, 4 in America, 2 in India, and 1 in Java; but the modern trade centres mainly in Amsterdam. The world's demands for the bark average from 14 to 18 million pounds, of which India contributes about five hundred thousand pounds.

It is therefore important that the Government should pay more attention to *cin-*

chona plantation than before. If some experts were sent to Java to study the condition of *cinchona* plantation and the manufacture of *quinine*, it would be a considerable help to the Government in facilitating further expansion of *cinchona* plantation in this country. The whole question requires to be thoroughly sifted, and we would urge upon the Government that a committee on the lines indicated above be appointed, with instructions to report as early as possible after going through the whole question as to the possibility of production of *cinchona* alkaloid not only for the needs of the country which means so much money saved, but also for its export to other countries of the world.—(*Indian Medical Record*, July, 1922.)

GENERAL NOTES.

THE LIGHT OF THE FIRE-FLY.

The *Journal of the Franklin Institute* for August gives details of an important investigation upon this subject. The matter has engaged the attention of many Physicists in England, and is of considerable interest; the paper in question is by Herbert E. Ives, Ph.D., and gives details of the spectroscopic and photometric properties of the phosphorescent light produced by fire-flies and glowworms. The radiation is found to be confined between the wave lengths λ 5000 and λ 6000, and the author ventures the assumption that the *total luminous efficiency* is in the neighbourhood of 90 per cent.

The research is an exceedingly valuable addition to our knowledge of this interesting luminosity, and emphasises the difference between our most efficient methods of illumination and that of the insect. The author concludes with a quotation from Professor Langley. "There seems to be no reason why we are forbidden to hope that we may yet discover a method of obtaining an enormously greater result than we now do from our present ordinary means for producing light."

The same publication contains a paper "On the effect of absorbed gas on the electrical conductivity of glass," by V. Bush and L. H. Connell,

and the results lead the authors to the conclusion that gases penetrate through the volume of both glass and quartz, and can be removed by vacuum treatment.

Langmuir found that the gases removed from glass by heating *in vacuo* consisted chiefly of water vapour. Recent researches carried out in connection with the technology of glass manufacture in England show that a certain amount of water enters into the composition of practically all glasses. The subject, bearing as it does upon the important dielectric properties of glass, is of very great value. We note with interest that the authors propose to continue the investigation.

FLOTATION OILS.

One of the most striking successes of the laboratories was the discovery of a substitute for pine oil, used in the oil flotation process of refining ore. This process is extensively used in Canada. As originally developed, the process could only be worked by the use of pine oil, a product of the pines of the Southern States. Owing to the enormous demand for pine oil which the discovery of this process created, the price rose to ten and fifteen times its original figure, and frequently for months at a time Canadian reduction plants were unable to get it at any price. In this extremity a number of Canadian mine owners appealed to the Minister of the Interior, and the Minister directed the laboratories to investigate the question. The investigators succeeded in making pine oil from Canadian red pine stumps, but at a cost too high to render its use commercially feasible. They went further, however, and after eight months' work succeeded in utilising a waste product of the wood distillation industry. This waste product, slightly refined, was found to do the work in the reduction plants just as well as the original article. In this investigation the Forest Products Laboratories had the co-operation of the Department of Mines, the experts of which tested in practical ore reduction the different oils produced; until a satisfactory one was obtained. Canadian mining companies expressed their great appreciation of the work of the investigators. There are already many achievements to the credit of the laboratories, and the volume of work is constantly increasing. — (*Natural Resources of Canada*, August, 1922.)

DEPOSITS OF SOAPSTONE IN NORTHERN ONTARIO.

MANY INDUSTRIAL USES FOR THE EASILY-WORKED MATERIAL.

What promises to be an important and valuable source of soapstone has lately been investigated by Mr. H. S. Spence, of the Mines Branch, Department of Mines. The deposit occurs one mile west of Wabigoon, on the Canadian Pacific Railway near Dryden, Ontario, and is but 500 yards from the railway. There is very little overburden, and the outcrops indicate a large body of soapstone.

The stone may be termed soapstone, though, beyond being soft enough to cut readily with an ordinary saw, it bears little resemblance to what is usually classed as soapstone. It is a dark, greenish-grey rock, composed largely of talc, and is very similar in appearance and in composition to the so-called "alberene stone" of Virginia, which is extensively used for switchboard panels, laboratory equipment and laundry tubs, and for lining furnaces and digesters, etc.

The Wabigoon deposit is the most promising, from an economic standpoint, of any of the soapstone occurrences as yet found in Canada; there appears to be large tonnage available, the location is ideal for quarrying, and close proximity to the railway provides satisfactory transportation facilities.—(*Natural Resources of Canada*, August, 1922.)

ROYAL SCHOOL OF MINES FRECHEVILLE RESEARCH FELLOWSHIPS.

The Imperial College of Science and Technology, South Kensington, London, S.W.7, with which the Royal School of Mines is incorporated, is offering two Research Fellowships of £300 a year each, tenable for one year and possibly renewable for a second year, to aid in carrying out any investigation or research connected with Mining, Mining Geology, Metallurgy, or the Technology of Oil, which in the opinion of the Selection Committee is of sufficient use or promise.

Applicants, who may be Associates of the Royal School of Mines or others, and preferably men with some practical experience, should apply in writing to the Secretary of the College (from whom further particulars may be obtained) before 1st September, 1922, giving the nature of the

proposed investigation, qualifications for the work and references.

It is anticipated that the Committee will make the awards by the end of November, so that the Fellowships and work may begin on 1st January, 1923. Holders will be expected to devote their whole time to the work, which may be conducted at the Imperial College, or in special circumstances elsewhere at the discretion of the Committee.—(*Institution of Mining and Metallurgy*, August, 1922.)

EGYPTIAN CHEMISTS' ASSOCIATION.

H.M. Commercial Agent for Egypt states that an Association of Egyptian Pharmaceutical Chemists has just been founded with the object of promoting the interests of pharmaceutical chemists generally; affording financial assistance to any of its members temporarily in need of same; to assist members in defending themselves legally in the event of their being sued in the Courts on a plea which affects the whole profession, and, generally, to develop a spirit of solidarity among the members of the profession.

According to the Egyptian Directory there are about 180 pharmacies in Cairo and nearly 100 in Alexandria.

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Latest Patent Applications.

- 21319—Attack, F. W.—Process of manufacturing carbazol derivatives. August 4.
- 21012—Calder, W. A. S.—Process for condensing acid fumes evolved during concentration of sulphuric acid. August 1.
- 21/51—Consortion für Elektrochemische Industrie Ges.—Process for purifying acetylene. August 1.
- 21011—Illingworth, S. R.—Treatment of shale, coal, etc., for removal of sulphur. August 1.
- 21173—Rickets, W. J.—Electrically inducing chemical action. August 3.

Specifications Published This Week.

- 156698—Nitrogen Corporation.—Synthesis of ammonia from its elements and catalyst therefor.
- 159461—Bakelite-Ges and Hessen, R.—Manufacture of condensation products from phenols and aldehydes.
- 163980—Barrett Co.—Manufacture of formaldehyde.
- 170264—Kobayashi, K.—Process of manufacturing liquid hydrocarbons from fish oils.
- 183323—Tyrer, D.—Manufacture of red oxide of iron.

Abstract Published This Week.

Pigments and Sulphonic Acids.—Patent No. 181584.—A Patent has been granted in this country to Messrs. Badische Anilin & Soda Fabrik, Ludwigshafen-on-Rhine, Germany, for process of obtaining green pigment colours.

They are obtained by the reaction of ferric or ferrous salts on a-nitroso-B-naphthol or its bisulphite compound; ferric salts may be used in theoretical quantity or in less amount, but when ferrous salts are employed, less than the theoretical amount may, however, be used in the theoretical amount. Preferably Turkey-red oil or other substance which causes the pigment to be produced in a finely-divided state, for instance sodium diisopropyl-naphthalene sulphonate, should be present. The reaction may be effected in the presence of the usual substrata, or these may be formed simultaneously. In examples ferric chloride, ferrous sulphate, and pyroligneous iron liquor are employed. Sodium diisopropyl-naphthalene sulphonate may be prepared by treating naphthalene-a-or-B-sulphonic acid solution with isopropyl alcohol.

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THE PRESIDENTIAL ADDRESS.

SOME ASPECTS OF ANIMAL MECHANISM.

*By Professor Sir C. S. Sherrington, G.B.E.,
Sc.D., D.Sc., LL.D., Pres.R.S.,
President of the Association.*

It is sometimes said that Science lives too much to itself. Once a year it tries to remove that reproach. The British Association meeting is that annual occasion, with its opportunity of talking in wider gatherings about scientific questions and findings. Often the answers are tentative. Commonly questions most difficult are those that can be quite briefly put. Thus, "Is the living organism a machine?" "Is life the running of a mechanism?" The answer cannot certainly be as short as the question. But let us, in the hour before us, examine some of the points it raises.

Of course for us the problem is not the why of the living organism but the how of its working. If we put before ourselves some aspects of this working we may judge for ourselves some at least of the contents of the question. It might be thought that the problem is presented at its simplest in the simplest forms of life. Yet it is in certain aspects more seizable in complex animals than it is in simpler forms. And so let us turn thither.

Our own body is full of exquisite mechanism. Many exemplifications could be chosen. There is the mechanism by which the general complex internal medium, the blood, is kept relatively constant in its chemical reaction, despite the variety of the food replenishing it and the fluctuating draft from and input into it from various organs and tissues. In this mechanism the kidney cells and the lung cells form two of the main sub-mechanisms. And one part of the latter is the delicate mechanism linking the condition of the air at the bottom of the lungs with that particular part of the nervous system which manages the ventilation of the lungs. On that ventilation depends the proper respiratory condition of

the blood. The nervous centre which manages the rhythmic breathing of the chest is so responsive to the respiratory state of the blood supplied to itself that, as shown by Drs. Haldane and Priestley some years ago, the very slightest increase in the partial pressure of carbon dioxide at the bottom of the lungs at once suitably increases the ventilation of the chest. And dovetailed in with this mechanism is a further one working for adjustment in the same direction. As the lung is stretched by each inbreath the respiratory condition of the nervous centre, already attuned to the respiratory quality of the air in the lungs, sets the degree to which inspiration shall fill them ere there ensue the opposite movement of outbreath. All this regulation, although the nervous system takes part in it, is a mechanism outside our consciousness. Part of it is operated chemically; part of it is reflex reaction to a stimulus of mechanical kind, though as such unperceived. The example taken has been nervous mechanism. If in the short time at disposal we confine our examples to the nervous system, to do so will have the advantage that in one respect that system presents our problem possibly at its fullest.

To turn therefore to another instance, mainly nervous. Muscles execute our movements; they also maintain our postures. This postural action of muscles is produced by nerve-centres which form a system more or less their own. One posture of great importance thus maintained is that of standing, the erect posture. This involves due co-operation of many separate muscles in many parts. Even in absence of those portions of the brain to which consciousness is adjunct the lower nerve-centres successfully bring about and maintain all this co-operation of muscles which results in the erect posture. For instance, the animal in this condition, if set on its feet, stands. It stands reflexly. More than that, it adjusts its standing posture to required conditions. If the pose of one of the limbs be shifted, that shift induces a compensatory shift in the other limbs, so that stability is retained. A turn of the creature's neck sidewise and the body and limbs of themselves take up a fresh attitude appropriate to the side-turned head. Each particular pose of the neck telegraphs off to the limbs and body a particular posture required from them, and that posture is then maintained so long as the neck posture is maintained. Stoop the creature's

neck and the forelimbs bend down as if to seek something on the floor. Tilt the muzzle upward and the forelimbs straighten and the hind limbs crouch as if to look up at a shelf. Purely reflex mechanism provides most kinds of ordinary postures.

Mere reflex action provides these harmonies of posture. The nerve-centres evoke for this purpose in the required muscles a mild, steady contraction, with tension largely independent of the muscle length and little susceptible to fatigue. Nerve-fibres run from muscle to nerve-centre. By these each change in tension or length of the muscle is reported to the activating nerve-centre. They say, "Tension rising, you must slacken," or conversely. There also play a part organs whose stimulation changes with change of their relation to the line of gravity. Thus, a pair of tiny water-filled bags set one in each side of the skull. In each of these a patch of cells endowed with a special nerve. Attached to hairlets of these cells a tiny crystalline stone whose pressure acts as a stimulus through them to the nerve. The nerve of each gravity-bag connects, through chains of nerve-centres, with the muscles of all the limbs and of one side of the neck. In the ordinary erect posture of the head the stimulation by the two bags right and left is equal, because the two gravity-stones then lie symmetrically. The result, then, is a symmetrical muscular effect on the two sides of the body, namely, the normal erect posture. But the right and left bags are mirror pictures of each other. If the head incline to one side the resulting slip, microscopic though it be, of the two stones on their nerve-patches makes the stimulation unequal. And from that slip there results exactly the right unsymmetrical action of the muscles to give the unsymmetrical pose of limbs and trunk and neck. An additional one postures the head itself on the neck; a second pair of tiny gravity-bags, in which the stones hang rather than press. These, when any cause inclining the head has passed, bring the head back at once to the normal symmetry of the erect posture. And these same bags manage the posturing of the eyes. The eye contributes to our orientation in space; for instance, to perception of the vertical. And for this the eyeball, that is the retina, has to be postured normally. The pair of little gravity-bags in the skull, which act to restore the head posture, act also on the eyeball muscles. Whichever way the head

turns, slopes, or is tilted, these adjust the eyeball's posture compensatingly, so that the retina still looks out upon its world from an approximately normal posture, retaining its old verticals and horizontals. As the head twists to the right the eyeball's visual axis untwists from the right. These reactions of head of head and eyes and body unconsciously take place when a bird wheels or slants in flight or a pilot stalls or banks his aeroplane. And all this work itself involuntarily as a pure mechanism, whose analysis we owe mainly to Prof. Magnus and Dr. de Kleijn, of Utrecht.

True, in such a glimpse of mechanism what we see mainly is how the machinery starts and what finally comes out of it; the intermediate elements of the process we know less of. Each insight into mechanism reveals more mechanism still to know. Thus, hardly was the animal's energy balance in its bearing upon food intake shown comfortably to conform with thermodynamics than came evidence of the so-called "vitamines." Unsuspected influence on nutrition by elements of diet taken in quantities so small as to make their mere calorie value quite negligible; thus, for the growing rat, to quote Professor Harden, a quantity of vitamin A of the order of $\frac{1}{500}$ milligram a day. Again, as regards sex determination, the valued discovery of a visible distinction between the nuclear threads of male and female brings the further complexity that in such cases sex extends throughout the whole body to every dividing cell. Again, the association of hereditary unit-factors, such as body colour or shape of wing, to visible details in the segmenting nucleus seemed to simplify by epitomising. But further insight tends to trace the inherited unit character not to the chromosome itself, but to balance of action between the chromosome group. As with the atom in this heroic age of physicists, the elementary unit assumed simple proves, under further analysis, to be itself complex. Analysis opens a vista of further analysis required. Knowledge of muscle contraction has, from the work of Fletcher and Hopkins on to Hill, Hartree, Meyerhof, and others, advanced recently more than in many decades heretofore. The engineer would find it difficult to make a motive machine out of white of egg, some dissolved salts, and thin membrane. Yet this practically is what Nature has done in muscle, and obtained a machine of high mechanical efficiency. Perhaps human ingenuity can

learn from it. One feature in the device is alternate development and removal of acidity. The cycle of contraction and relaxation lies traced to the production of lactic acid from glycogen and its neutralisation chiefly by alkaline proteins; and physically to an admirably direct transition from chemical to mechanical effect. What new steps of mechanism all this now opens! To arrive at one goal is to start for others.

But knowledge, while making for complexity, makes also for simplification. There seems promise of simplification as to the mechanism of reflex action. Reflex action with surprising nicety calls into play just the appropriate muscles, and adjusts them in time and in the suitable grading of their strength of pull. The moderating as well as the driving of muscles is involved. Also the muscles have to pass from the behest of one stimulus to that of another, even though the former stimulus still persist. For these gradings, coadjustments, restraints, and shifts various separate kinds of mechanism were assumed to exist in the nerve-centres, although of the nature of such mechanisms little could be said. Their processes were regarded as peculiar to the nerve-centres and different from anything that the simple fibres of nerve-trunks outside the centres can produce. We owe to Lucas and Adrian the demonstration that without any nerve-centre whatever an excised nerve-trunk with its muscle attached can be brought to yield, besides conduction of nerve impulses, the extinction or attenuation or augmentation of them. That is remarkable, because the impulse is not gradable by grading the strength of the stimulus. Any stimulus of strength sufficient to excite the nerve-fibre at all, excites in it an impulse which is the fullest which the nerve-fibre can at the time give. The energy of the impulse comes not from the stimulus, but from the fibre itself. Lucas and Adrian have shown it gradable in another way. Though the nerve impulse is a quite brief affair—it lasts about $\frac{1}{1000}$ second at any one point of the nerve—it leaves behind it in the nerve-fibre a short phase during which the fibre cannot develop a second impulse. Then follows rapid but gradual recovery of the strength of impulse obtainable from the fibre. That recovery may swing past normal to super-normal before final return to the old resting state. Hence, by appropriately timing the arrival of a second impulse after a first, that second impulse may be extinguished or re-

duced or increased or transmitted without alteration. This property of grading impulses promises a complete key to reflex action if taken along with one another. The nervous system, including its centres, consists of nothing but chains of cells and fibres. In these chains the junctions of the links appear to be points across which a large impulse can pass, though a weak one will fail. At these points the grading of impulses by the interference process just outlined can lead, therefore, to narrowing or widening of their further distribution, much as in a railway system the traffic can be blocked or forwarded, condensed or scattered. Thus the distribution and quantity of the muscular effect can be regulated and shifted not only from one muscle to another, but in one and the same muscle can be graded by adding to or subtracting from the number of fibres activated within that muscle. As pointed out by Prof. Alexander Forbes, it may be, therefore, that the nerve impulse is the one and only reaction throughout the whole nervous system, central and peripheral, trains of impulses simply interfering, colliding and over-running as they travel along the inter-connected branches of the conductive network. In this may lie the secret of the co-ordination of reflexes. The nerve-centre seems nothing more than a meeting-place of nerve-fibres, its properties but those of impulses in combination. Fuller knowledge of the mechanism of the nervous impulse, many of whose physical properties are now known, a reaction open to study in the simplest units of the nervous system, thus leads to a view of nervous function throughout that system much simpler than formerly obtained.

Yet for some aspects of nervous mechanism the nerve impulse offers little or no clue. The fibres of nerve-trunks are perhaps of all nerve-structures those that are best known. They constitute, for instance, the motor nerves of muscle and the sensory nerves of the skin. When they are broken the muscle or skin is paralysed. They establish their ties with muscle and skin during embryonic life. These ties they then maintain practically unaltered throughout the individual's existence, and show no further growth. If severed, say, by a wound, they die for their whole length between the point of severance and the muscle or skin they go to. And then at once the cut ends of the nerve-fibres start re-growing from the point of severance, al-

though for years they have given no sign of growth. The fibre, so to say, tries to grow out to reach to its old far-distant muscle. There are difficulties in its way. A multitude of non-nervous repair cells growing in the wound spin scar tissue across the new fibre's path. Between these alien cells the new nerve-fibre threads a tortuous way, avoiding and never joining any of them. This obstruction it may take many days to traverse. Then it reaches a region where the sheath-cells of the old dead nerve-fibres lie altered beyond ordinary recognition. But the growing fibre recognises them. Tunnelling through endless chains of them, it arrives finally, after weeks or months, at the wasted muscle-fibres which seem to have been its goal, for it connects with them at once. It pierces their covering membranes and re-forms with their substance junctions of characteristic pattern resembling the original that had died weeks or months before. Then its growth ceases, abruptly, as it began, and the wasted muscle recovers and the lost function is restored.

Can we trace the causes of this beneficent yet so unaccountable reaction? How is it that severance can start the nerve regrowing? How does the nerve-fibre find its lost muscle microscopically miles away? What is the mechanism that drives and guides it? Is it a chemotaxis like that of the antherozoid in the botanical experiment drawn towards the focus of the dissolved malic acid? If so, there must be a marvellously arranged play of intricate sequences of chemically attractive and repellent substances dissolved suitably point to point along the tissue. It has recently been reported that the nerve-fibre growing from a nerve-cell in a nutrient field of graded electrical potential grows strictly by the axis of the gradient. Some argue for the existence of such potential gradients in the growing organism. Certainly nerve regeneration seems a return to the original phase of growth, and pieces of adult tissue removed from the body to artificial nutrient media in the laboratory take on vigorous growth. Professor Champy describes how epithelium that in the body is not growing when thus removed starts growing. If freed from all fibrous tissue its cells not only germinate, but, as they do so, lose their adult specialisation. In nerve regeneration the nerve-sheath cells, and to some extent the muscle-cells which have lost their nerve-fibre, lose likewise their specialised form,

and regain it only after touch with the nerve-cell has been re-established. So similarly epithelium and its connective tissue cultivated outside the body together both grow and both retain their specialisation. All seems to argue that the mutual touch between the several cells of the body is decisive of much in their individual shaping and destiny. The severance of a nerve-fibre is an instance of the dislocation of such a touch. It recalls well-known experiments on the segmenting egg. Destruction of one of the two halves produced by the first segmentation of the egg results in a whole embryo from the remaining half-egg. But if the two blastomeres, though ligated, be left side by side, each then produces a half-embryo. Each half-egg *can* yield a whole embryo, but is restrained by the presence of the twin cell to yielding but a half one. The nerve severance seems to break a mutual connection which restrained cell growth and maintained cell differentiation.

It may be said that the nerve-sheath cells degrade because absence of transmission of nerve impulses leaves their fibre functionless. But they do not degrade in the central nerve-piece, although impulses no longer pass along its afferent fibres. This mechanism of reconstruction seems strangely detached from any direct performance of function. The sprouting nerve-fibres of a motor nerve with impulses for muscular contraction can by misadventure take their way to denervated skin instead of muscle. They find the skin-cells whose nerve-fibres have been lost, and on these they bud out twigs, as true sensory fibres would do. Then, seemingly satisfied by so doing, they desist from further growth. The sense-cells, too, after this misunion, regain their normal features. But this joining of motor nerve-fibre with sense-cell is functionless, and must be so because the directions of functional conduction of the two are incompatible.

So similarly a regenerating skin-nerve led down to muscle makes its union with muscle instead of skin, though the union is a functional misfit, and cannot subserve function. Marvellous though nerve regeneration be, its mechanism seems blind. Its vehemence is just as great after amputation, when the parts lost can of course never be re-reached. Its blindness is sadly evident in the suffering caused by the useless nerve-sprouts entangled in the scar of a healing or healed limb-stump.

But there is a great difference between the growth of such regeneration and the growth impulse in pieces of tissue isolated from the body and grown in media outside. With pure cultures of these latter Professor Champy says the growth recalls in several features that of malignant tumours. Multiplication of cells unaccompanied by formation of a specialised adult tissue. A piece of kidney cultivated outside the body de-differentiates, to use his term, into a growing mass unorganised for renal function. But with connective-tissue cells added even breast-cancer epithelium will in cultivation grow in glandular form. New ground is being broken in the experimental control of tissue growth. The report of the Imperial Cancer Research Fund mentions that in cultivation outside the body malignant cells present a difficulty that normal cells do not. To the malignant cells the nutrient soil has to be more frequently renewed, because they seem rapidly to make the soil in which they grow poisonous to themselves, though not to normal cells. The following of all clues of difference between the mechanism of malignant growth and of normal is fraught with importance which may be practical as well as theoretical.

The regenerating nerve rebuilds to a plan that spells for future function. But throughout all its steps prior to the actual reaching the muscle or skin no actual performance of nerve-function can take place. What is constructed is functionally useless until the whole is complete. So similarly with much of the construction of the embryo in the womb for purposes of a different life after emergence from the womb; with the construction of the butterfly's wing within the chrysalis for future flight; of the lung for air-breathing after birth; of the reflex contraction in the foetal child of the eyelids to protect the eye long before the two eyelids have been separated, let alone ere hurt or even light can reach it. The nervous system in its repair, as in its original growth, shows us a mechanism working through phases of non-functioning preparation in order to forestall and meet a future function. It is a mechanism against whose seeming prescience is to be set its fallibility and its limitations. The how of its working is at present chiefly traceable to us in the steps of its results rather than in comprehension of its intimate reactions; as to its mechanism, perhaps the point of chief import for us here is that

those who are closest students of it still regard it as a mechanism. But if to know be to know the causes we must confess to want of knowledge of how its mechanism is contrived.

And if we knew the whole how of the production of the body from egg to adult, and if we admit that every item of its organic machinery runs on physical and chemical rules as completely as do inorganic systems, will the living animal present no other problematical aspect? The dog, our household friend—do we exhaust its aspects if in assessing its sum-total we omit its mind? A merely reflex pet would please little even the fondest of us. True, our acquaintance with other mind than our own can only be by inference. We may even hold that mind as object of study does not come under the rubric of Natural Science at all. But this Association has its Section of Psychology, and my theme of to-night was partly chosen at the instance of a late member of it, Dr. Rivers, the loss of whom we all deplore. As a biologist he viewed mind as a biological factor. The keeping of mind and body apart for certain analytic purposes must not allow us to forget their being set together when we assess as a whole even a single animal life.

Taking as manifestations of mind those ordinarily received as such, mind does not seem to attach to life, however complex, where there is no nervous system, nor even where that system, though present, is quite scantily developed. Mind becomes more recognisable the more developed the nerve-system. Hence the difficulty of the twilit emergence of mind from no mind, which is repeated even in the individual life history. In the nervous system there is what is termed localisation of function, relegation of different work to the system's different parts. This localisation shows mentality, in the usual acceptance of that term, not distributed broadcast throughout the nervous system, but restricted to certain portions of it. Thus, among vertebrates to the relatively newer parts of that forebrain. Its chief, perhaps its sole, seat is a comparatively modern nervous structure superposed on the non-metal and more ancient other nervous parts. The so-to-say mental portion of the system is placed so that its commerce with the body and the external world occurs only through the archaic non-mental rest of the system.

(To be Continued)

A STUDY OF THE GLOW OF PHOSPHORUS.—PERIODIC LUMINOSITY AND ACTION OF INHIBITING SUBSTANCES.

By LORD RAYLEIGH, F.R.S.

(Reprinted by permission from the *Proceedings of the Royal Society, A*, Vol. 99.)

(Continued from Page 117).

6. EXPERIMENTS WITH AMMONIA.

Ammonia gives effects like camphor. Its solubility in water, and the convenient control obtained by diluting the solution, makes it suitable for tests of how the period is controlled by the strength of the inhibiting substance, when air is admitted at a definite rate. The vessel used was a cylindrical bottle, 18 cm. long, and 6 cm. diameter. A capillary tube admitted air so as to raise the pressure 7 mm. of mercury per hour. The same capillary remained in use throughout the experiments with ammonia. A slice of phosphorus was hung up about 1 cm. above the layer of liquid at the bottom of the bottle (fig. 3).

Observations were made on the time required after evacuation for the pulses to begin, and also on the period. The latter was rather irregular at first, and somewhat longer than the steady value given, which was attained after the first few flashes had passed. Some residual irregularity remained, however, even when this comparatively steady state had been reached.

Ammonia density.	Time before first flash. minutes.	Period. minutes.
[1.00*	1.1	0.033]
0.997	4.5	0.43
0.994	12.0	0.55
0.982	52.0	1.2
0.965	150.0	3.1
0.960	More than 240	4.1
0.955	Character of phenomena changed	

* Water only.

Both the period and the time taken for the pulses to begin increase with the strength of the ammonia, but the latter time increases much more rapidly.

The time-lag before beginning measures the oxygen required to be present (1 minute = 0.023 mm. oxygen pressure), and the period measures on the same scale the oxygen consumed at each flash; for the

steady *régime* implies that the oxygen consumed at each flash is the amount which leaks in during one period.

It appears, then, that the fraction of the whole stock-in-trade, so to speak, of oxygen, which is consumed at one flash, diminishes when stronger ammonia is used, and the period becomes slower. With the weakest ammonia, about one-tenth of the whole amount present was consumed at each flash; with the strongest, less than one-sixtieth. It is not surprising, in the light of this, that the successive periods vary considerably in length. These periodic pulses, arising suddenly, travelling from one end of the vessel to the other, with completely dark intervals between them, are attributed to the combustion of the phosphorus vapour already present in the tube. Immediately after a pulse has passed, all the phosphorus vapour is consumed and a fresh quantity evaporates during the dark interval between the pulses.

Obviously, if this *régime* is to be followed, there is a limit to the period, under the condition of constant influx, as in the present experiments with ammonia. The period cannot be longer than the time required to admit enough oxygen to burn the whole of the saturated phosphorus vapour.

If we take the phosphorus molecule as P_4 , oxidising to P_2O_5 , it will combine with five times its volume, and hence with five times its partial pressure of oxygen. The careful measurements of Centnerszwer* give the vapour pressure of phosphorus vapour at 20° C. as 0.025 mm. This would require 0.125 mm. of oxygen for its complete combustion.

In the experiments with ammonia of longest period (4.1 minutes) the oxygen entering in a period is 4.1×0.023 mm. = 0.094 m.m. This is 0.75 of the amount required for complete combustion, and therefore it might be anticipated that the limiting period for simple pulses has practically been reached.

Experiment confirms this. When the ammonia concentration is increased still further it is found that the character of the *régime* changes entirely, though it still remains periodic. Thin pulses no longer travel down the vessel, and there are no

* 'Zeit. Physik. Chemie,' vol. 85, p. 99 (1913).

longer completely dark intervals. The space round the phosphorus is filled with a diffuse luminosity, which increases periodically in brightness, but which is never reduced to zero and is not propagated through the vessel in a detached pulse right away from its place of origin. In this case the conditions which determine the period are altogether different. The quantity of phosphorus vapour burnt during a period is not limited by the saturation pressure, since the amount of evaporation while combustion is actually proceeding is no longer insensible.

7. SOME UNCLASSIFIED OBSERVATIONS.

In addition to the phenomena described above, some others have been noticed which have not been investigated in detail. Thus in the experiments with camphor, I have sometimes seen a faint glow in the vessel before the passage of the brilliant pulse and heralding the approaching catastrophe. Sometimes, too, a faint glow remained for a second or two after the passage of the pulse.

Placing iodine in the vessel, the phosphorus surface would under some conditions light up and become abruptly extinguished again in a curious manner. It was thought that in this case chemical combination between phosphorus and iodine introduced some complication.

8. PROBABLE MODE OF ACTION OF INHIBITING SUBSTANCES IN PREVENTING THE OXIDATION OF PHOSPHORUS.

The power possessed by a trace of ethylene or turpentine or ammonia in hindering the glow of phosphorus has always seemed very strange and difficult to explain. It is sometimes said to be an example of "negative catalysis," but this phrase is not of much help.

Although no complete account can yet be given, the present experiments seem to show in what direction the explanation lies.

Consider a luminous wave travelling through a vessel containing phosphorus, air, and some inhibiting substance. When once this wave has been started, it is propagated through the vessel. This implies that combustion in any layer is started by contact with a previous layer which is already in the act of combustion. Now why does contact with the layer already in combustion produce this effect? In the case of a mixture of oxygen and hydrogen the reply would be that the high temperature de-

veloped by combustion heats the neighbouring layer and starts that into combustion also. In the present case such an explanation is scarcely tenable, for the rise of temperature to be expected is too small. Consider the propagation in the experiment of p. 116 when the vessel was filled with nitrogen at atmospheric pressure. Let us suppose that the phosphorus vapour was saturated and that the whole of it was burnt—the least favourable supposition for the argument. Taking the vapour pressure as 0.025 mm. (Centnerszwer, *loc. cit.*) and the molecule as P_4 , a litre of nitrogen contains 0.181 mgrm. of phosphorus. The complete combustion of this quantity would give 1.07 calories, and this would only heat the containing atmosphere of nitrogen 3.6° . This, then, is the highest temperature which could be communicated to a neighbouring layer in which combustion had not yet begun. It may well be doubted whether so small a rise could determine the propagation of combustion: but there is evidence that propagation takes place under much less favourable conditions even than this.

We have supposed that in the experiments with camphor at atmospheric pressure, the full saturation quantity of phosphorus is being burnt. In the much less brilliant and more frequent pulses obtained in presence of water vapour, the quantity burnt must be much less—at a moderate estimate, *e.g.*, five times less. But we may go further still: for in some experiments (see p. 115) the pulses obtained in presence of water vapour, faint at the best, become much fainter still as they progress, and are reduced in intensity, perhaps five times further still, before they finally die out.

In this latter case, if we take the brightness as a measure of the rate of combustion, as it appears reasonable to do, we must suppose that perhaps not more than 0.04 of the saturated concentration of phosphorus vapour is being consumed. This would only give a rise of temperature of about $0.14^\circ C.$, and it is still harder to believe that this would determine propagation.

If propagation is not due to rise of temperature, what is it due to? I think we must attribute it to the provision of nuclei.

There is a well known experiment on supersaturation which will illustrate what is meant. A supersaturated solution of,

c.g., sodium acetate, is contained in a long glass tube. If a fragment of the crystallised salt is dropped in at one end, crystallisation is propagated along the tube. The crystallisation of any given layer provides nuclei which determine the crystallisation of the next layer.

Similarly, I think we must suppose that the combustion of phosphorus provides nuclei which facilitate the action. The action postulated has some analogy with the action of platinum or other solid surfaces in promoting union of hydrogen and oxygen. The gaseous or particulate products of combustion of phosphorus are assumed to act somewhat similarly.

Coming now to the inhibiting substances, I think these must be supposed that these act by taking prior possession of the nuclei, and thus making them unavailable for propagation. That water, and still more, ammonia in presence of water, would seize on the products of oxidation of phosphorus, is no more than we may anticipate from the acid-forming character of the latter. In the case of camphor or turpentine, the kind of action here assumed has become familiar in studies of the mobility of gaseous ions in air at atmospheric pressure. The ions tend to unite with gaseous molecules, as evidenced by their diminished mobility in an electric field; and this effect is highly selective. A trace of water vapour or of an organic vapour has far more tendency to load the ions than a full atmosphere of nitrogen or hydrogen.*

The original spontaneous ignition is regarded as due to something which, from a molecular point of view, is a rare accident, concerning a few molecules only. Unless it can be spread and multiply, it effects practically nothing: being in this respect like a single microbe in the putrefaction of wounds. The presence of a small quantity of a vapour like oil of turpentine, by attaching itself to the product, prevents the latter from inducing the combination of the neighbouring phosphorus molecules. From this point of view, it is not specially surprising that a very small quantity of the inhibiting substance should

in some cases be enough to stop the action. It is often quoted as a surprising fact that one part of ethylene in 400 parts of air inhibits the glow of phosphorus. But, after all, even at this dilution, the partial pressure of the ethylene is still about 100 times the saturation pressure of the phosphorus vapour itself. There can be little doubt that the glow of phosphorus is in all cases due to the oxidation of vapour, since the phenomenon may be traced continuously from atmospheric pressure to low pressures, and in the latter case occurs visibly at a distance from the phosphorus surface. At low pressures the vapour has a chance to diffuse away to some distance before getting oxidised.

Where, as in the periodic luminous pulses, an increasingly favourable composition of the phosphorus-oxygen mixture eventually starts a wave of combustion in spite of the inhibitor, we must suppose that the action of the inhibitor in destroying the nuclei is overwhelmed by the too rapid multiplication of the latter; just as the too rapid multiplication of invading bacteria in a wound may overwhelm the destructive action of the phagocytes and enable infection to spread.

The question may be asked why some of the inhibiting substances — like water, camphor, and ammonia — lend themselves so much more readily to the formation of intermittent luminous pulses than others, like turpentine and eucalyptus oil. As already shown, the latter class can be made to give the effect by dilution, but not so well.

Striking as the difference is, it is probably not very fundamental—not perhaps more fundamental than the condition of “hunting” or not hunting in a self-regulating mechanism, such as a steam engine governor or an automatic arc lamp.

In these cases a general explanation of the action of the mechanism is by no means sufficient to determine whether it will “hunt” or not. Nor can the provisional theory of the action of inhibiting substances which has been given be expected to do so.

9. SUMMARY.

The paper deals with the intermittent or periodic luminosity observed to be propagated through the gas space when the last traces of oxygen are being removed from air by means of phosphorus, or when the air is allowed slowly to leak into an exhausted vessel containing phosphorus.

* To avoid misconception it is well to state specifically that I do not assume that the ions produced in the oxidation of phosphorus have necessarily anything to do with the matter.

(1) It is shown that this effect, as ordinarily observed, requires the presence of water vapour. Moderate drying (*e.g.*, by sulphuric acid) makes the glow perfectly steady. Water vapour has therefore the power of inhibiting the combination of phosphorus vapour and oxygen within certain limits. When the composition of the mixture becomes favourable beyond those limits, a wave of combustion is propagated.

(2) Other substances are known to inhibit the glow of phosphorus. Some of these can be used to exhibit the above phenomena in a far more striking form than water. Camphor, ammonia, and pear oil are among the most effective, and experiments with them are described in detail.

(3) It is shown that the propagation of these waves of combustion cannot be attributed to the rise of temperature of one layer igniting the next layer, for the rise of temperature is too small. An alternative theory of the propagation is proposed which assumes that it depends on the provision of nuclei, as in the propagation of crystallisation through a super-cooled liquid.

(4) On this basis a theory of the action of the inhibitors (sometimes called "negative catalysts") is developed.

[END.]

ALUMINA.

HYDROLYSIS OF ALUMINUM SALTS.

By *Wilder D. Bancroft*.

(From the *Journal of Physical Chemistry*, June, 1922.)

(Continued from Page 120).

Ganswindt¹ believes in distinguishing sharply between the mordanting of wool and of cotton. "The mordanting of cotton is quite different from the mordanting of wool and silk; it has also quite a different intention and significance. The cause of the difference is the inactivity or indifference of cotton towards solutions of salts of the metals. While silk and wool take up the metals in any form on heating, often

quantitatively, and fix them chemically, that is not the case with cotton. Cotton has no affinity for metal salts and no tendency to form metallo-organic compounds; even boiling for hours has no effect. It is therefore necessary to have recourse to solutions of strongly basic salts, solutions which are so labile that a mere diluting with water, gentle heating, or just the presence of a textile fibre will cause the solution to dissociate into a normal solution and into a precipitate, which latter, at the moment of precipitation, is taken up on or in the fibre. It is not necessary to decide whether the hydroxide is taken up or a more basic salt than that in the original solution, for that point has no bearing on what is to follow. It is a fact, however, that no chemical compound is formed, and that the cotton fibre is not changed chemically in any way by the mordanting or, more properly speaking, by the steeping in the salt solution. Strictly speaking the cotton is not mordanted at all. When cotton is mordanted, the phenomenon is different from that with wool and silk, in that actually the metal hydroxide or possibly a very strongly basic salt is precipitated mechanically on the cotton fibre and can be removed to some extent by vigorous rinsing. The hydroxide that is left is also held mechanically, but in the intercellular spaces.

"The mordanting with tannin and tartar emetic must also be considered as a mechanical process, for there is only a very slight affinity between tannin and cellulose. If one mordants cotton with tannin, it is possible to wash the tannin out quantitatively by repeated treatments with hot water. That is why it is necessary to fix tannin with tartar emetic. Cotton mordanted with tannin and tartar emetic is nothing more than cotton impregnated mechanically with antimony tannate. It is exactly similar when cotton is mordanted with Turkey red oil and aluminum acetate. In all cases the cotton itself remains entirely unchanged. It is not altered or affected chemically in any way and therefore one really ought not to call the process mordanting at all. The only case where there is actually a chemical change in cotton by the action of reagents is curiously enough not called mordanting but *merecrisisation*.

"From all this it is clear that the mordanting of cotton is not at all the same thing as the mordanting of wool. The

¹ "Theorie und Praxis der modernen Färberei, II., 214 (1903).

mordanting of wool is pre-eminently a chemical process, while the mordanting of cotton is a mechanical impregnation of insoluble metallic compounds in the cell spaces and pores of the cotton fibre. For this reason the mordanting of cotton with metallic salts is nothing like as important or interesting as the mordanting of wool. The organic mordants, tannin and oil, are much more important."

This is quite an unreasonable attitude to take. The difference between wool and cotton is purely one of degree, so far as we now know. Wool adsorbs alumina more strongly than cotton does, and is therefore able to take up alumina from less basic solutions than cotton. Since it adsorbs alumina more strongly than cotton does, it also holds it more firmly, thus makes a fixing of the mordant unnecessary. That point will be discussed in detail in a later paper. There is no satisfactory experimental evidence as yet of the formation of any definite chemical compound between alumina and either wool or cotton. Specific adsorption will account satisfactorily for all the phenomena which have been observed as yet.

It is interesting to note that the one case where Ganswindt is willing to admit a chemical change and a consequent mordanting is that of mercerised cotton; and Leighton has since shown that all the earlier work on the theory of the process was wrong, and that there is no definite chemical compound formed when cotton is mercerised. It is true, of course, that mercerised cotton does adsorb basic and substantive dyes more strongly than ordinary cotton does, and it is apparently true that mercerised cotton takes up basic mordants rather more completely from concentrated solutions than ordinary cotton does; but there is no reason to suppose that this is anything more than an increased adsorption due to a change in structure.

The general results of this paper are:

1. All aluminum salts hydrolyze more or less in aqueous solution and the amount of the hydrolysis increases with rising temperature.

- 1 *Jour. Phys. Chem.*, 20, 188 (1916).
 - 2 *Matthews*: "Application of Dyestuffs," 165, 278 (1920).
 - 3 *Schaposchnikoff and Minajeff*: *Zeit. Farben-Ind.*, 3, 165 (1904); 4, 81 (1905).
2. The actual hydrolysis is greater with weaker acids; but the apparent hydrolysis

may be abnormally large in sulphate solutions owing to the coagulating effect of the sulphate ions on the colloidal alumina.

3. The different fibres adsorb alumina to different degrees, wool having a much greater adsorbing power than cotton, and silk being probably slightly inferior to wool.

4. Owing to this difference in specific adsorption, wool decomposes aluminum salt solutions which are distinctly acid, while cotton is effective only in more basic solutions.

5. What is taken up and held firmly is the colloidal alumina. While coagulated alumina may be adsorbed to some extent, it rubs off easily.

6. It is probable that in all cases alumina is adsorbed and not a basic salt. The phenomena may be complicated by the fact that the alumina itself will adsorb some sulphuric acid, for instance, and that the wool may, and probably does, adsorb some sulphuric acid also.

7. Since alumina is adsorbed less strongly by cotton than by wool, it is also held less strongly by cotton than by wool.

8. If we add to cotton some substance like tannin which adsorbs alumina strongly, the cotton mordanted with tannin will be able to take alumina out of aluminum salt solutions which are not decomposed by cotton alone. A corollary from this is that alumina will be held more strongly by cotton mordanted with tannin than by cotton alone.

9. The increase in adsorbing power shown by mercerised cotton is undoubtedly due to structural difference in the cotton fibre; but we are not yet able to predict this change.

10. There is no evidence of the formation of any definite chemical compound between alumina and either wool, silk, or cotton.

Cornell University.

[END.]

INSTITUTE OF CHEMISTRY.

THE PRESIDENT'S ADDRESS.

By A. Chaston Chapman, F.R.S., March 1st, 1922.

(Continued from Page 125.)

The whole chemical industry—and I include, of course, all those industries which are essential to the successful conduct of war—the prosecution of scientific research, with all that that implies, and the practical

teaching of science in our schools and universities, all depend upon a supply of laboratory glassware, porcelain and chemicals, adequate in quantity, suitable in quality, and, I would add, reasonable in price.

With the political aspect of this matter I have, as President of the Institute, no concern, but on national grounds it is obviously desirable that this country should be ever directing its activities to production and to the increasing development of its internal resources, with the consequent creation of new wealth, rather than to distribution.

There is, moreover, the further consideration—and it is one which is very much in the mind of the Council—that the establishment in this country of these essentially chemical industries would lead to increasing demand for the services of properly qualified chemists.

I am prepared to admit that there may be certain appliances and certain chemicals which, for sufficiently good reasons, can be better manufactured by firms in other countries, with whom it might be very difficult, or even impossible, for us to compete successfully, and I have no hesitation in expressing the view that if our own manufacturers cannot supply apparatus and chemicals of the necessary high quality and at a suitable price, these must be obtainable elsewhere, without let or hindrance.

I do not think, however, that British manufacturers should feel that they can count not only on such encouragement as the Government can give them, but also upon a very full measure of the support and sympathy of those in whose interests, and at whose instance, the industries in question were established.

From the purely commercial point of view, the manufacture of highly specialised apparatus and of very pure chemicals, both of which are needed in comparatively small quantities, cannot be particularly attractive. Unless, therefore, British firms do receive such support as I have referred to, these newly born industries must languish and ultimately disappear.

If there were evidence that British manufacturers are not prepared to do their best to supply our needs, the matter would not call for further discussion, but I submit that such information as we have goes to show that great progress has been made under difficult circumstances, and that, in

respect of these necessary tools of our profession, there is no good reason why we should not make ourselves self-supporting. So far as laboratory glassware is concerned, the Special Purposes Committee have received a good many expressions of satisfaction, and, for some time past, very few complaints; and, so far as porcelain is concerned, so great has been the progress made that the British ware now obtainable compares very favourably, both in quality and in price, with that imported from Germany and elsewhere.

The supplies of British Analytical Reagents are, generally speaking, very good indeed, and, as an example of the enterprise which has been shown by British manufacturers in connection with the supply of chemicals required for research purposes, it may be mentioned that more than two thousand British-made substances are now obtainable, and that the list is being daily extended.

I might perhaps venture to suggest that, when comparison is made between British-made glassware, porcelain and chemicals, and similar articles of foreign origin, such comparison should be between British articles known to be of recent manufacture, and the corresponding imported articles of post-war, and not of pre-war origin.

This matter is still receiving the very careful consideration of the Special Purposes Committee and of the Council, and it is hoped that much good may result from the deliberations of the Committee which has just been formed under the chairmanship of Sir Joseph Petavel, Director of the National Physical Laboratory. That Committee, which is a very representative one, will deal with the standardisation of volumetric apparatus, and of bench-blown and furnace-blown scientific glassware, as well as with the chemical and physical properties of glass. The bringing together in friendly discussion of those who manufacture the apparatus, those who use it, and those on whom rests the responsibility of testing and certifying its accuracy, should tend to clear away many misunderstandings, and to facilitate fruitful co-operation.

Turning now for a few moments to what I may describe as the more purely domestic activities of the Institute, I would like to refer with especial pleasure to the resumption of the lectures, and to congratulate the lectures and library Committee on

having provided two such interesting and instructive discourses as that by Dr. E. J. Russell on "Modern Applications of Chemistry to Crop Production," and that by Mr. Ballantyne on "Chemists and the Patent Laws." Both these lectures were greatly appreciated on the occasions of their delivery, and I am confident that in the form of additions to the Institute's series of monographs, they will be found very useful, not only by our younger members, but also by many of our Fellows in practice.

I am informed that our library is increasingly used by our members and students, and I am also glad to have the opportunity of referring to the arrangement made with the Chemical Society, under which our members have the use of the library at Burlington House. That this privilege is greatly appreciated is shown by the records kept by the Society's librarian, and I think we shall all agree that the contribution which we make to the Society is money well spent. Whatever views we may hold in regard to the advantages or disadvantages attaching to the existence of a number of independent chemical societies, we must agree that there is often avoidable duplication of activities, accompanied by unnecessary expenditure, both of energy and of means. The formation of a truly representative library, devoted to chemistry and allied subjects, must therefore commend itself to us all. Small collections of chemical books—hardly to be dignified by the word "libraries"—must exist for reasons of convenience, and I have already referred to our own, which is chiefly intended for the use of our students and examination candidates, but it is obviously desirable, in the interests of chemists and of chemistry, that at least one great and comprehensive collection should be made, and for this important function the Chemical Society is best fitted and clearly indicated. I hope that our Treasurer, who, I have reason to know, is quite sympathetic, will not think that I am trenching upon his domain, if I say that I trust that our contributions will be as liberal as the state of our finances may permit. May I also express the hope that the existence of the privilege of using the Society's library will not have the effect of deterring any members of the Institute from seeking admission to the Society, and from helping to further by every means in their power the great work which it is doing.

I feel very strongly that one of the wisest and most statesmanlike steps ever taken by the Institute was the formation of the local sections. Not only had this the effect of putting the government of the Institute on a more truly representative basis, and of enabling the Council to keep more closely in touch with the views and with the needs of our members, wherever resident, but it stimulated—as perhaps nothing else could have done—the multifarious activities of the Institute, and gave substantial expression to the fact set forth in our title—and of which we may well be proud—that we are in very truth the Institute of Chemistry of Great Britain and Ireland. A reference to our *Journal* will suffice to show the great variety of subjects debated at the sectional meetings, and scarcely a Council meeting passes without some correspondence from one or more of the sections raising matters needing discussion in the interests of the profession as a whole.

The election of Members of Council is this year conducted under the new by-laws, and for the first time in the history of the Institute we have a directly competitive ballot. The new system is in accord with the views expressed by the local sections, and is designed to give to the main body of our members a more direct voice in the choice of the Council. Time will show how this system works in practice, but of this I am convinced, that whatever may be the result of the ballot this year, we shall have a strong and representative Council, and one which will devote itself actively and conscientiously to the work before it.

I may, perhaps, just remind you that the district members of Council returned in January sit on terms of equality with the General Members of Council, and have an equal voice in all that concerns the working and the welfare of the Institute. Our members have always regarded it as an honour and a privilege to serve the Institute in any official capacity, and many of us know how whole-heartedly they have thrown themselves into the work, and how freely they have given of their often very limited leisure.

As President, I have perhaps had an exceptional opportunity of witnessing the readiness with which men, already heavily burdened with affairs, have responded to very onerous demands upon their services in the interests of the Institute, and one need not fear for the future of a profession

which numbers so many of such men within its ranks.

To the Honorary Treasurer, I have already expressed my sense of indebtedness, and I desire to offer my warmest thanks to the Vice-Presidents, Members of Council, Chairmen of Committees and others, who have done so much to lighten my labours, and to make my year of office a very happy one.

To Professor Morgan and to Mr. Stubbs, both of whom retire from the office of Vice-President, our very especial thanks are due for the assiduity and devotion which they have shown to the affairs of the Institute.

To the retiring Members of Council, also, our warmest thanks are due. Some—like Mr. Watson Gray—have been astonishingly regular in their attendance, notwithstanding the large amount of valuable time which long railway journeys must have involved, and all have ungrudgingly given not only their time, but their special knowledge and experience, to the services of the Institute.

Of the work of our Committees, it is impossible to speak too highly. A glance at the report of the Council will suffice to show how many meetings have been held and how many important subjects have been dealt with. On the Nominations, Examinations and Institutions Committee falls, I need scarcely say, a very full share of hard work. Where all have worked so well, it is perhaps invidious to refer to any one member, but I feel that the Council would like me to take this opportunity of expressing to Mr. Hawkins our thanks for his continued services as Acting Chairman, at what must often have been considerable personal inconvenience.

The Legal and Parliamentary Committee, under the able Chairmanship of Mr. Ballantyne, has proved to be a most useful institution, as is shown by the action we have taken with regard to various measures before Parliament, and other matters of legal importance concerning the profession.

To Mr. Pilcher I do not know how to express my gratitude at all adequately. It is not too much to say that, without his ever-ready help, his great experience of Institute matters, placed always at my service, and his wise advice so willingly given, my occupancy of this chair would have been scarcely possible. I would also like, in this connection, to express my great

personal obligation to Mr. Marlow, as well as to Miss Cawston and to the members of the office staff generally.

I am informed by the Registrar that, although we have 3,511 Fellows and Associates on our register, the number of our members known to be actually out of appointments is less than 70. Whilst our sympathy goes out to those who are thus temporarily deprived of employment, we have, I think, some reason to congratulate ourselves that the position is no worse.

Having regard to the increasing number of qualified chemists whom our universities are turning out, and at a time of almost unparalleled industrial depression, it is, I think, cause for congratulation that the percentage of unemployment is so small. I believe—at any rate, I sincerely hope—we may draw from this the comforting inference that employers are looking more and more to science to help them in overcoming technical difficulties, and in improving their manufacturing operations.

On the other hand, I would like to utter a note of warning. The chemical profession, like most other professions, is at the moment overcrowded, and the demands it makes on those who enter its ranks are very great, and are year by year becoming greater. Many parents still retain the impression that chemistry is a rapid road, if not to wealth, at least to a comfortable competency, and that it differs from the other professions in involving a much less expensive course of preparation. I think it well, therefore, that it should be known as widely as possible by all young men and women who may be considering the adoption of chemistry as a profession, that a keen love of the subject is essential to success, and that they must be prepared to face a great deal of hard and often unattractive work, and to make the very real sacrifices which a professional career inevitably involves.

I am well aware that there are exceptional persons to whom ordinary rules and considerations do not apply, but so far as the average chemical student is concerned, the course of training must be of the University character if success is to be ultimately attained, and the training will therefore make the same demands upon the financial resources of parents as medicine, the law, or any other of the learned professions. The sooner this fact is generally realised the better for all concerned.

This leads me to a matter in which I personally feel a very keen interest, and which demands the earnest co-operation of all our Fellows and Associates. I refer to the part which the Institute can and ought to take in helping the future generation of chemists, so far as they are represented by our registered students. I need not, perhaps, say that our students have not only ready access to the offices of the Institute, but that a great deal of time and kindly attention is devoted to them by the Executive officers. I feel, however, that something more than this is necessary. We have no desire to intervene in any way between teachers and their students, our object being rather to bring those students at an early stage of their career into touch with the realities of professional life. If, in doing this, we can introduce a little more of the personal element and show a little more active sympathy, it will, I am convinced, be all to the good. The local sections are doing what they can to further this aim, but I am hopeful that the Institute may be able to do even more than it has yet done to make the students feel that we are genuinely interested in their present welfare, as well as in their future success.

I should like to conclude this address, which has necessarily been of a discursive and unconnected character, on a note of optimism. Even as a separate branch of physical science, chemistry, as distinct from alchemy, is of comparatively recent birth, whilst as a profession—using that word in the sense in which it is understood to-day—it may be said to have come into existence within the lifetime of many of us in this room.

In these circumstances, the present position of our profession should inspire us with a feeling of pride and of deep satisfaction, and should have the effect of stimulating us all to increased endeavours to raise it still higher, and to that position of pre-eminence which it is surely destined to occupy.

There is scarcely a department of human activity which is not influenced more or less profoundly by the discoveries and developments of chemistry; nor is there a single individual in the community whose comfort has not been increased, and whose daily life has not been made happier—or at least, more tolerable—through the beneficent operations of the science we cultivate and profess. What discoveries in

chemistry the future may hold, and in what way those discoveries may still further modify the material life of man, none can say, but I think it is not unlikely that if any distinctive term should be applied by the historian of the future to the era on which we are now entering, he will describe it as the "Age of Chemistry."

That the immediate outlook for professional chemistry is not brighter need cause no astonishment, but the present period of industrial depression will pass in time, and I feel confident that before long we shall see opening out before us a prospect such as the chemists of the past generation could never have thought possible. Of the future, I have never indeed felt any doubt, but we have it in our power as individuals to hasten or to retard the progress which we all so ardently desire to see. Remembering this—our individual responsibility—let us keep ever before us the highest professional ideals of duty and conduct, and strive to be worthy in every sense of our great calling.

GENERAL NOTES.

THE INSTITUTE OF METALS.

NEW SERIES OF LECTURES.

A notable feature of the forthcoming Swansea meeting of the Institute of Metals will be the inauguration of a series of annual public lectures on "Subjects of Practical Interest to those engaged in the Non-Ferrous Metals Industry." The lectures are additional to the well-known annual May lectures of the Institute of Metals, which have constituted a notable feature of the Institute's work since 1910.

Dr. R. S. Hutton, a Member of Council of the Institute, and Director of the British Non-Ferrous Metals Research Association, is to deliver the first of the new lectures, this being entitled, "The Science of Human Effort (Motion Study and Vocational Training)." The lecture will be given at 8 p.m. on Tuesday, September 19, at the Y.M.C.A., Swansea.

Tickets can be obtained from Mr. G. Shaw Scott, 36, Victoria Street, London, S.W.1, who will be glad to send particulars of Membership of the Institute to persons desirous of taking part in the subsequent

proceedings at Swansea. These include the discussion of fifteen papers on various metallurgical subjects, civic and other receptions and entertainments, visits to works and a motor tour round the Gower Peninsula, the entire meeting lasting from Tuesday, September 19th, to Friday, September 22nd, and constituting an excellent opportunity of combining instruction with pleasure.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

Engineer Vice-Admiral Sir George Goodwin, K.C.B., late Engineer-in-Chief of the Fleet, and Dr. James Colquhoun Irvine, C.B.E., F.R.S., Vice-Chancellor and Principal of St. Andrews University, have been appointed by an Order of Council dated the tenth day of August, 1922, to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

SELENIUM SALTS.

V. LENHER.

Two further publications by this author described the properties of selenium oxychloride and selenium oxybromide (*J. Am. Chem. Soc.*, 1922, p. 1664, 1668). In studying the oxychloride it is important to have the salt free from even traces of water, as if such are present, quite different results will be obtained, e.g., increased conductivity. A good method is to treat dry selenium dioxide and fused selenium with dry chlorine. Dry selenium dioxide, prepared by burning the metal in oxygen, very rapidly absorbs atmospheric moisture. To detect traces of moisture in the oxychloride, a little of the sample is treated with perfectly dry cobalt carbonate, when the pink colour of the latter will turn blue. Precautions hence to be taken to prevent absorption of water from the air during the test. When perfectly dry, the oxychloride is without action on the dry carbonates of Ca, Sr, Cu, Ni, Co, Fe. With BaCO_3 and MgCO_3 carbon dioxide is slowly evolved. Sodium and potassium carbonates rapidly give off CO_2 . The author states that selenium oxychloride acts as an oxidising acid chloride, both oxidising and chlorinating. Selenium oxybromide can be prepared by brominating the theoretical amounts of pure dry selenium dioxide and fused selenium, the necessary bromine be added to the flask through a tap funnel and atmos-

pheric moisture being excluded by fitting a calcium bromide tube to the flask also. The flask is kept at 0°C to prevent loss of bromine. The contents of the flask are then gently warmed to dissolve all the dioxide. The oxybromide is a reddish yellow solid M.P. 41.5 to 41.7°C , B.P. 217°C at 740 mm. with decomposition. It readily decomposes on even slight heating. Its density at 50°C is 3.38 , and electrical conductivity at 45°C 6×10^{-10} . It is hydrolysed by water to selenious and hydrobromic acids. In chemical reactions it is disised and brominated.—(*Journal American Chemical Society*.)

NOTE ON THE PICOLINOYLAMINO-ANTHRAQUINONES.

By E. DE BARRY BARNETT, B.Sc., F.I.C.

The α -benzoylaminoanthraquinones have marked tinctorial properties, and several compounds of this nature have been placed on the market as dyes, e.g., Algol Yellow W.G. (α -benzoylaminoanthraquinone). All these compounds are completely insoluble in water, and are used as vat dyes, the dyebath being prepared in the usual manner by means of an alkaline solution of sodium hydrosulphite, and the colour subsequently developed by exposing the yarn to the air.

It seemed of interest to ascertain if the introduction of a strongly basic group into the molecule would lead to the formation of water-soluble derivatives that would be capable of dyeing on a tannin mordant, and with this object in view α -picolinoylaminoanthraquinone was prepared, as it was hoped that subsequent treatment with an alkyl halide would lead to a soluble quaternary (pyridinium) salt. This hope was not realised as the picolinoylamino compound shows no tendency to combine with alkyl halides. For the sake of comparison the β -picolinoylamino compound was also prepared, and was found to differ from the deep yellow α -isomer by being almost colourless. This difference in colour seems to be common to all the acylaminoanthraquinones, and it is only the α -compounds which have tinctorial properties which are of any value.

α -Picolinoylaminoanthraquinone. Picolinic acid hydrochloride (5.3 grams) was boiled under reflux with 20 grams of thionyl chloride, the condenser being closed by means of a calcium chloride tube to exclude atmospheric moisture. After about $2\frac{1}{2}$ hours' complete solution had taken

place, and the excess of thionyl chloride was then removed by distillation at 12 mm. pressure from a tepid water bath. To the crude picolinoyl chloride thus obtained a solution of 5 grams of α -aminoanthraquinone in 100 cc. of tetrachlorethane was added, and the whole heated under reflux on the water bath for an hour. During this heating a certain amount of black resinous matter separated, and this was removed by filtering the hot solution. The filtrate was cooled to about 50°, and then diluted with its own volume of alcohol. After complete cooling, the yellow precipitate was collected and washed first with alcohol and then with ether. It was purified by recrystallisation from boiling pyridine, and after washing with ether was dried in a vacuum desiccator over concentrated sulphuric acid. (Found: N = 8.30. $C_{20}H_{12}O_3N_2$ requires N = 8.54 per cent.). α -Picolinoylaminoanthraquinone forms a deep yellow crystalline powder which melts and decomposes at 282-284°. On alkaline reduction it forms a red vat, but reduction takes place slowly and with considerable difficulty.

β -Picolinoylaminoanthraquinone. The preparation was carried out as described above, but no resinous matter separated. The tetrachlorethane solution was, therefore, cooled without filtration and the yellow precipitate collected, dilution with alcohol being unnecessary. After washing with ether the compound was purified by recrystallisation from pyridine. (Found: C = 73.6, H = 3.86. $C_{21}H_{12}O_3N_2$ requires C = 73.2, H = 3.70 per cent.).

β -Picolinoylaminoanthraquinone is almost colourless, and melts at 257-258°. After drying in a vacuum desiccator it takes up an electric charge with remarkable ease, so much so, in fact, before weighing it out for analysis it was found necessary to make the powder into tablets.

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The Science Reports of the Tôhoku Imperial University, Japan, contain a valuable paper by Junzô Okubo on the "Lanthanum Violet Bands and the Associated Lines." The material used was a specimen of nitrate prepared by Kurlbaum, inserted into a rod of Acheson Graphite. The spectroscopic apparatus was a large Rowland Concave Grating, "Ilford" or "Seed No. 27" plates were used. A table of wave lengths is given and an accuracy of $\pm 0.007 \text{ \AA}$ is claimed for the measurements.

In the summary it is stated that "The wave lengths of the edges of the lanthanum violet bands are measured in a new international scale, and the opinion is confirmed that each band is of double structure, and that some of them have been missed by previous investigators.

"By introduction of the quanta theory the bands are explained as due to molecular rotation caused by line emissions, the connections being the double structure of the edges of bands necessary in consequence of the same nature of the original lines."

New Patents.

THIS list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs can be obtained gratuitously.

Latest Patent Applications.

- 21914—Alexander, A. E.—Synthetic resins, and process of making same. August 11.
- 21507—Babcock & Wilcox, Ltd.—Furnaces. August 8.
- 21717—Farbwerke vorm. Meister, Lucius, & Bruning.—Manufacture of thiopyridins. August 9.
- 22006—Farbwerke vorm. Meister, Lucius, & Bruning.—Manufacture of alkylated acids and derivatives thereof. August 12.
- 21738—Hansging, F.—Electrolysis of zinkiferous materials. August 9.
- 21824—Marcotte, P. L. G.—Processes for utilization of luminescent and catalytic substances. August 10.

Specifications Published This Week.

- 160427—Pacz, A.—Method of producing high temperatures and the use thereof for reducing refractory oxides.
- 183527—Nesfield, A. C.—Means for desulphurising oils.
- 183629—Anderson, D. G., and MacLaurin, R.—Preparation of synthetic resins.
- 165788—Adler, Dr. R.—Process for the manufacture of decolourising-charcoal of high activity.

Abstract Published This Week.

Sulphur Sulphides.—Patent No. 181984.—A new process for preparing Sulphur Sulphides has been devised by Mr. B. Hunt, of 16, South St., London. Sulphur in a pure state is recovered from an aqueous emulsion in which it occurs with gangue or other earthy matter by heating under pressure in an autoclave to a temperature above the melting-point of sulphur, but not exceeding 165° C., the emulsion being agitated. Under these conditions the sulphur melts and may be separated by gravity from the aqueous liquid, the gangue, &c., remaining in suspension. The process may be applied to the mixture of sulphur and "fine dust" obtained in the treatment of certain metallurgical gases. If, in addition to sulphur and gangue, metallic sulphides are present in the emulsion, they coalesce with the sulphur (which may be added if the amount originally present is insufficient) when the latter is melted as described above, the gangue remaining in suspension as before.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

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THE PRESIDENTIAL ADDRESS.

SOME ASPECTS OF ANIMAL MECHANISM.

By Professor Sir C. S. Sherrington, G.B.E.,
Sc.D., D.Sc., LL.D., Pres.R.S.,
President of the Association.

(Continued from Page 133.)

Simple nerve impulses, their summations and interferences, seem the one uniform office of the nerve-system in its non-mental aspect. To pass from a nerve impulse to a psychical event, a sense-impression, percept, or emotion is, as it were, to step from one world to another and incommensurable one. We might expect, then, that at the places of transition from its non-mental to its mental regions the brain would exhibit some striking change of structure. But no; in the mental parts of the brain still nothing but the same old structural elements, set end to end, suggesting the one function of the transmission and collision of nerve impulses. The structural inter-connections are richer, but that is a merely quantitative change.

I do not want, and do not need, to stress our inability at present to deal with mental actions in terms of nervous actions, or *vice versa*. But facing the relation borne in upon us as existent between them, may we not gain some further appreciation of it by reminding ourselves even briefly of certain points of contact between the two? Familiar as such are I will merely mention rather than dwell upon them.

One is the so-called expression of the emotions. The mental reaction of an emotion is accompanied by a nervous discharge which is more or less characteristic for each several type of emotion, so that the emotion can be read from its bodily expression. This nervous discharge is involuntary, and can affect organs, such as the heart, which the will cannot reach. Then there is the circumstance that the peculiar ways and tricks of the nervous machinery as revealed to us in the study of pure reflex reactions repeat themselves obviously in the working of the

machinery to which mental actions are adjunct. The phenomenon of fatigue is common to both, and imposes similar disabilities on both. Nervous exhaustion and mental exhaustion mingle. Then, as off-set against this disability, there exists in both the amenability to habit formation, mere repetition within limits rendering a reaction easier and readier. Then, and akin to this, is the oft-remarked trend in both for a reaction to leave behind itself a trace, an engram, a memory, the reflex engram, and the mental memory.

How should inertia and momentum affect non-material reactions? Quick though nervous reactions are, there is always easily observed delay between delivery of stimulus and appearance of the nervous end effect; and there is always the character that a reaction once set in motion does not cease very promptly. Just the same order of lag and overrun, of want of dead-beat character, is met in sense-reactions. The sensation outlives the light which evoked it and for longer the stronger the reaction. Just so the reflex after-discharge persists after the stimulus is withdrawn, and subsides more slowly the stronger the reaction. The times in both are of the same order. Again, a reflex act which contracts one muscle commonly relaxes another. Even so along with rise of sensation in one part of the visual field commonly occurs lapse of sensation in another. And the stoppage is in both by inhibition, that is to say, active. Then again, two lights of opposite colour falling simultaneously and correspondingly on the two retinae will, according to their balance, fuse to an intermediate tint or see-saw back and forth between the one tint and the other. Just similarly a muscle impelled by two reflexes, one tending to contract it, the other to relax it, will according to the balance of these respond steadily with an intensity, a compromise between the two, or see-saw rhythmically from extreme to extreme of the two opposite influences.

Reflex acts commonly predispose to their opposites. So similarly the visual impression of one colour predisposes to that of its opposite. Again, the *position* of the stimulated sensual point acts on the mind—hence the light seen or the pain felt is referred to some locus in the mind's space-system. Just similarly the reflex machinery directs, for instance, the limb it moves towards the particular spot stimulated. And such

spots in the two processes, mental and non-mental, correspond.

Characteristic of the nervous machinery is its arrangement in what Hughlings Jackson called "levels," the higher levels standing to the lower not only as drivers but also as restrainers. Hence in disease underaction of one sort is accompanied by overaction of another. Thus in the arm affected by a cerebral stroke, besides loss of willed—that is higher level—power in the finger muscles, there is in other muscles involuntary overaction owing to escape of lower centres from control by the higher which have been destroyed. So similarly with the sensory effects. Of skin sensations some are painful and some not, for instance touch. The seat of the latter is of higher level, cortical; of the former lower, sub-cortical. When cerebral disease breaks the path between the higher and the underlying level a result is impairment of touch sensation but heightening of pain sensation in the affected part. The sensation of touch, as Dr. Head says, restrains that of pain.

Thus features of nervous working resemble over and over again mental. Is it mere metaphor when we speak of mental attitudes as well as bodily? Is it mere analogy to liken the warped attitude of the mind in a psychoneurotic sufferer to the warped attitude of the body constrained by an internal potential pain? Again, some mental events seem spontaneous; in the nervous system some impulses seem generated automatically from within.

It may be said of all these similarities of time-relation and the rest between the ways of the nervous system and such simpler ways of mind as I here venture on, that they exist because the operations of the mental part of the nervous system communicate with the exterior only through the non-mental part as gateway. That there, then, the features of the nerve-machinery are impressed on the mind's working. But that suggestion forgets that the higher and more complex the mental process, the longer the time-lag, the more incident the fatigue, the more striking the memory character, and so on.

Yet all this similarity does but render more succinct the old enigma as to the nexus between nerve impulse and mental event. In the proof that the working of the animal mechanism conforms with the first law of thermodynamics, can one say that psychical events are evaluated in the balance sheet drawn up? And, on the other hand, Mr. Barcroft and his fellow-

observers in their recent physiological exploration of life on the Andes at 14,200 ft. noted that, as well as were their muscles, their arithmetic there was at a disadvantage. The low oxygen pressure militated against both. Indeed we all know that in any of us a few minutes without oxygen, or a few more with chloroform, and the psychical and the nervous events will lapse together. The nexus between the two sets of events is strict. But for comprehension of its nature we still require, it seems, comprehension of the unsolved mystery of the how of life itself. A shadowy bridge between them may lie perhaps in the reflection that for the observer himself the physical phenomena he observes are in the last resort psychical.

The practical man has to accept nervous function as a condition for mental function without breaking his heart over ignorance of their connection. The doctor, the lawyer, and we all, accept it. We know that with structural derangement or destruction of certain parts of the brain goes mental derangement or defect, while derangement or destruction of other parts of the nervous system is not so accompanied. Decade by decade the connection becomes more ascertained between certain mental performances and certain cerebral regions. Certain impairments of ideation as shown by forms of incomprehension of language or of familiar objects can help to diagnose for the surgeon as to what part of the brain a tumour is compressing; and the tumour gone the mental disabilities pass. So similarly those who, as Professor Elliott Smith and Sir Arthur Keith, recast the shape of the cerebrum from the cranial remains of prehistoric man can outline for us something of his mentality from examination of the relative development of the several brain regions, using a true and scientific phrenology.

Could we look quite naively at the question of a seat for the mind within the body we might perhaps suppose it diffused there, not localised in any one particular part at all. That it is localised and that its localisation is in the nervous system—can we attach meaning to that fact? The nervous system is that bodily system whose special office from its earliest appearance onward throughout evolutionary history has been more and more to weld together the body's component parts into one consolidated mechanism reacting as a unity to the changeful world about it. It more than any other system has constructed out of a

collection of organs an individual of unified act and experience. It represents the acme of accomplishment of the integration of the animal organism. That it is in this system that mind, as we know it, has had its beginning, and with the progressive development of the system has step for step developed, is surely significant. So is it that in this system the portion to which mind transcendently attaches is exactly that where are carried to their highest pitch the nerve-actions which manage the individual as a whole, especially in his reactions to the external world. There, in the brain, the integrating nervous centres are themselves further compounded, inter-connected, and re-combined for unitary functions. The cortex of the forebrain is the main seat of mind. That cortex with its twin halves corresponding to the two side-halves of the body, is really a single organ knitting those halves together by a still further knitting together of the nervous system itself. The animal's great integrating system is there still further integrated. And this supreme integrator is the seat of all that is most clearly inferable as the animal's mind. As such it has spelt biological success to its possessors. From small beginnings it has become steadily a larger and larger feature of the nervous system, until in adult man the whole rest of the system is relatively dwarfed by it. Not without significance, perhaps, is that in man this organ, the brain cortex, bifid as it is, shows unmistakable asymmetry. Man is a tool-using animal, and tools demand asymmetrical, though attentive and therefore unified, acts. A nervous focus unifying such motor function will, in regard to a laterally bipartite organ, tend more to one half or the other. In man's cerebrum the preponderance of one-half, namely, the left, over the other may be a sign of unifying function.

It is to the psychologist that we must turn to learn in full the contribution made to the integration of the animal individual by mind. But each of us can, without being a professed psychologist, yet recognise one achievement in that direction which mental endowment has produced. Made up of myriads of microscopic cell-lives, individually born, feeding and breathing individually within the body, each one of us nevertheless appears to himself a single entity, a unity experiencing and acting as one individual. In a way the more far-reaching and many-sided the reactions of which a mind is capable the more

needed, as well as the more scope, for their consolidation to one. True, each one of us is in some sense not one self, but a multiple system of selves. Yet how closely those selves are united and integrated to one personality. Even in those extremes of so-called double personality one of their mystifying features is that the individual seems to himself at any one time wholly either this personality or that, never the two commingled. The view that regards hysteria as a mental dissociation illustrates the integrative trend of the total healthy mind. Circumstances can stress in the individual some perhaps lower instinctive tendency that conflicts with what may be termed his normal personality. This latter, to master the conflicting trend, can judge it in relation to his main self's general ethical ideals and duties to self and the community. Thus intellectualising it, he can destroy it or consciously subordinate it to some aim in harmony with the rest of his personality. By so doing there is gain in power of will and in personal coherence of the individual. But if the morbid situation be too strong or the mental self too weak, instead of thus assimilating the contentious element the mind may shun and, so to say, endeavour to ignore it. That way lies danger. The discordant factor escaped from the sway of the conscious mind produces stress and strain of the conscious self: hence, to use customary terminology, dissociation of the self sets in, bringing in its train those disabilities, mental or nervous or both, which characterise the sufferer from hysteria. The normal action of the mind is to make up from its components one unified personality. When we remember the manifold complexity of composition of the human individual, can we observe a greater instance of solidarity of working of an organism than that presented by the human individual intent and concentrated, as the phrase goes, upon some higher act of strenuous will? Physiologically the supreme development of the brain, psychologically the mental powers attaching thereto, seem to represent from the biological standpoint the very culmination of the integration of the animal organism.

The mental attributes of the nervous system would be, then, the coping-stone of the construction of the individual. Surveyed in their broad biological aspect, we see them carrying integration even further still. They do not stop at the individual; they proceed beyond the individual; they

integrate from individuals communities. When we review, as far as we can judge it, the distribution of mind within the range of animal forms, we meet two peaks of its development—one in insect life, the other in the vertebrate, with its acme finally in man. True, in the insect the type of mind is not rational but instinctive, where as at the height of its vertebrate development reason is there as well as instinct. Yet in both one outcome seems to be the welding of individuals into societies on a scale of organisation otherwise unattained. The greatest social animal is man; the powers that make him so are mental. Language, tradition, instinct for the preservation of the community, as well as for the preservation of the individual. Reason actuated by emotion and sentiment and controlling and welding egoistic and altruistic instincts into one broadly harmonious, instinctive-rational behaviour. Just as the organisation of the cell-colony into an animal individual receives its highest contribution from the nervous system, so the further combining of animal individuals into a multi-individual organism, a social community, merging the interests of the individual in the interests of the group, is due to the nervous system's crowning attributes, the mental. That this integration is still in process, still developing, is obvious from the whole course of human pre-history and history. The biological study of it is essentially psychological; it is the scope and ambit of social psychology. Not the least important form of social psychology is that relatively new one, of which the President of the Psychology Section at this meeting is a foremost authority and exponent, namely, that dealing with the stresses and demands that organised industry makes upon the individual as a unit in the community of our day, and with the readjustments it asks from that community.

To resume, then, we may, I think, conclude that in some of its aspects animal life presents to us mechanism the how of which, despite many gaps in our knowledge, is fairly explicable. Of not a few of the processes of the living body, such as muscular contraction, the circulation of the blood, the respiratory intake and output by the lungs, the nervous impulse and its journeyings, we may fairly feel from what we know of them already that further application of physics and chemistry will furnish a competent key. We may suppose that in the same sense as we can claim to-

day that the principles of working of a gas-engine or an electro-motor are comprehensible to us, so will the bodily working in such mechanisms be understood by us, and indeed are largely so already. It may well be possible to understand the principle of a mechanism which we have not the means or skill ourselves to construct. We cannot construct the atoms of a gas-engine. But, turning to other aspects of animal mechanism, such as the shaping of the animal body, the conspiring of its structural units to compass later functional ends, the predetermined natural term of existence, these, and their intimate mechanism, we are, it seems to me, despite many brilliant inquiries and inquirers, still at a loss to understand. The steps of the results are known, but the springs of action still lie hidden. Then again, the how of the mind's connection with its bodily place seems still utterly enigma. Similarity or identity in time-relations and in certain other ways between mental and nervous processes does not enlighten us as to the actual nature of the connection existent between the two. Advance in biological science does but serve to stress further the strictness of the nexus between the two.

Great differences of difficulty therefore confront our understanding of different aspects of animal life. Yet the living creature is fundamentally a unity. In trying to make the how of an animal existence intelligible to our imperfect knowledge we have for purposes of study to separate its whole into part-aspects and part-mechanisms, but that separation is artificial. It is as a whole, a single entity, that the animal, or for that matter the plant, has finally and essentially to be envisaged. We cannot really understand its one part without its other. Can we suppose a unified entity which is part mechanism and part not? One privilege open to the human intellect is to attempt to comprehend, not leaving out of account any of its properties, the how of the living creature as a whole. The problem is ambitious, but its importance and its reward are all the greater if we seize and we attempt the full width of its scope. In the biological synthesis of the individual it regards mind. It includes examination of man himself as acting under a biological trend and process which is combining individuals into a multi-individual organisation, a social organism surely new in the history of the planet. For this biological trend and

process is constructing a social organism whose cohesion depends mainly on a property developed so specifically in man as to be, broadly speaking, his alone, namely, a mind actuated by instincts but instrumented with reason. Man, often Nature's rebel, as Sir Ray Lankester has luminously said, can, viewing this great supra-individual process, shape even as individual his course conformably with it, feeling that in this instance to rebel would be to sink lower rather than to continue his own evolution upward.

BRITISH ASSOCIATION.

SECTION B.—CHEMISTRY.

PART I.—THE ORGANISATION OF RESEARCH.

ADDRESS BY PRINCIPAL J. C. IRVINE,
C.B.E., D.Sc., LL.D., F.R.S.

President of the Section.

I am deeply sensible of the honour done to me in electing me to this chair, and am well aware of my own unworthiness to occupy the position. Nevertheless, I feel that there is something appropriate in the choice which brings once more into close relationship the University of St. Andrews and the British Association. You will forgive me if, for the moment, my thoughts are focussed not so much on the subject assigned to our Section as on the origin and nature of this annual gathering of scientists.

The British Association was the product of an age rather than the inspiration of any one man, yet of those who first gave practical effect to the movement which has spread scientific learning and has bound its devotees in a goodly fellowship there was no more eager spirit than Sir David Brewster. It is not an exaggerated claim that it was he who founded the British Association. One may trace his enlightened action to a desire to combat the apathy and distrust shown by the Government of his day towards scientific work and even scientific men. Only in the historical sense can I claim any relationship with Brewster. It is my privilege to occupy the Principalship he once held, and I cannot escape from the thought that the daily tasks now mine were once his.

It is thus inevitable that today a name often in my mind should spring once more

into recollection, especially as my distinguished predecessor was present at the first Hull meeting in 1853, when he contributed two papers to Section A. Chemists should be among the first to pay grateful tribute to Brewster's efforts on behalf of science, and I propose, therefore, to include in my address a review of the position scientific chemistry has won since his day in public and official estimation. Moreover, at the express suggestion of some of our members whose opinions cannot be disregarded, I am induced to add the consideration of the new responsibilities chemists have incurred now that so many of Brewster's hopes have been realised. These were recently submitted by me to another audience and, through the medium of an article in *Nature*, are possibly known to you already, but I agree with my advisers that their importance warrants further elaboration and wider discussion.

It would be idle to recall the lowly position of chemistry as an educative force in this country, or to reconstruct the difficulties with which the scientific chemist was confronted during the first thirty years of the nineteenth century. Present difficulties are serious enough, and press for all our attention, without dwelling unduly on troubles of the past. But we must at least remember that in the early days of the British Association "schools" of chemistry were in their infancy, and that systematic instruction in the science was difficult to obtain. Another point of fundamental importance which has to be borne in mind is that the masters of the subject were then for the most part solitary workers.

It is difficult for us, looking back through the years, to realise what it must have meant to search for truth under conditions which were discouraging, if not actually hostile. Yet, although his labours were often thankless and unrewarded, the chemist of the time was probably a riper philosopher and a finer enthusiast than his successor of to-day. He pursued his inquiries amidst fewer distractions, and in many ways his lot must have been happy, save when tormented by the thought that a subject so potent as chemistry in developing the intellectual and material welfare of the community should remain neglected to an extent which to us seems incredible.

Public sympathy was lacking, Government support was negligible or grudgingly bestowed, and there was little or no co-operation between scientific chemistry and

industry. As an unaided enthusiast the chemist was left to pursue his way without the stimulus, now happily ours, which comes from the feeling that work is supported by educated and enlightened appreciation.

Let me quote from one of Faraday's letters now in my possession and, so far as I can trace, unpublished. Writing to a friend immediately before the foundation of the British Association, he relates that a manufacturer had adopted a process developed in the course of an investigation carried out in the Royal Institution. The letter continues: "He" (the manufacturer) "writes me word that, having repeated our experiments, he finds the product very good, and as our information was given openly to the world he, as a matter of compliment, has presented me with some pairs of razors to give away." If ever there was a compliment which could be described as empty, surely this was one; yet the letter gives the impression that Faraday himself was quite content with his reward.

It is perhaps unfair to quote Faraday as a type, for few men are blessed with his transparent simplicity of character, but there is obviously a great gulf fixed between the present day and a time when a debt of honour could be cancelled in such a manner. A little reflection will show that the British Association has played a useful part in discrediting the idea that because so much scientific discovery is given "openly to the world," those who profit by such discoveries should be absolved from their reasonable obligations. Even where scientific workers do not expect or desire personal reward, the institutions which provide them with their facilities are often sorely in need. The recognition, not yet complete, but more adequate than once was the case, that the labourer is worthy of his hire represents only one minor change which the years have brought.

An even greater contrast, embodying more important principles, is found in the changed attitude of the State towards scientific education and discovery. Remember Brewster's fond hope that, by means of our Association, the whole status of science would be raised, and that a greater measure of support and encouragement would be received from the Government. How eagerly the venerable physicist must have listened to the Presidential Address delivered at the twenty-third meet-

ing of the Association assembled in Hull for the first time. It dealt with many problems familiar to him. No doubt he followed with keen interest the account of the observations on Nebulæ made with Lord Rosse's telescope, and appreciated the references to the work of Joule and Thomson. The address was a masterly synopsis of scientific progress, but from time to time a new note steals in. There is a significant reference to a consultation with the Chancellor of the Exchequer, another to a conversation with Mr. Gladstone, and a third to a working arrangement concluded with the Admiralty. These would fall sweetly on Brewster's ear, and he would cordially approve of the report of our Parliamentary Committee which had established sympathetic contact with the House of Commons. He could not fail to be impressed with the changes a few years had brought.

Let us bridge the further gap of sixty-nine years which separates us from that day. The contrast is amazing, and once more we can trace the steady, persistent influence of the British Association in bringing about what is practically a revolution in public and official opinion. We have learned many lessons. The change has come suddenly, but it was not spontaneous. Many years had to be spent in disseminating the idea that research is a vital necessity, and toward this end Presidents of our Association have not hesitated year after year, to add the weight of their influence and eloquence. It was courageous of them to do so. I would refer you particularly to the forcible appeals made by Sir James Dewar at Belfast and Sir Norman Lockyer at Southport, when the plea for more research was laid before the Association, and thus found its way by the most direct channel to the Press and to the public. No doubt many other factors have played a part in creating a research atmosphere in this country, but the steady pressure exerted by the British Association is not the least important of these influences.

The principles of science are to-day widely spread; systematic scientific training has found an honourable place in the schools and in the colleges; above all, there is the realisation that much of human progress is based on scientific inquiry, and at last this is fostered, and, in part, financed as a definite unit of national educational policy. Public funds are devoted to provide

facilities for those who are competent to pursue scientific investigations, and in this way the State, acting through the Department of Scientific and Industrial Research, has assumed the double responsibility of providing for the advancement of knowledge and for the application of scientific methods to industry. Scientists have been given the opportunities they desired, and it remains for us to justify all that has been done. We have this morning glanced briefly at the painful toil and long years of preparation; now it falls to us to sow the first crop and reap the first harvest.

Thanks to the wisdom and foresight of others, it has been possible to frame the Government policy in the light of the experience gained with pre-existing research organisations. The pioneer scheme of the kind is that administered by the Commissioners of the 1851 Exhibition, who since 1890 have awarded research scholarships to selected graduates. When in 1901 Mr. Carnegie's benefaction was applied to the Scottish Universities the trustees wisely determined to devote part of the revenues to the protection of research awards which take the form of Scholarships, Fellowships, and Research Lectureships. These have proved an immense boon to Scottish graduates, and the success of the venture is sufficiently testified by the fact that the Government Research scheme was largely modelled on that of the Carnegie Trust.

In each of these organisations chemistry bulks largely, and the future of our subject is intimately connected with their success or failure. The issue lies largely in our hands. We must not forget that we are only at the beginning of a great movement, and that fresh duties now devolve upon us. It was my privilege for some years to direct the work of a Chemistry Institute, where research was organised on lines which the operation of the Government scheme will make general. If, from the very nature of things, my experience cannot be lengthy, it is at least intimate, and I may perhaps be allowed to lay before you my impressions of the problems we have to face.

Two main objectives lie before us: the expansion of useful learning and the diffusion of research experience among a selected class. This class in itself will form a new unit in the scientific community, and from it will emerge the "exceptional man" to whom, quoting Sir James Dewar, "we owe our reputation and no small part of our prosperity." When these words were uttered in 1902 it was a true saying that

"for such men we have to wait upon the will of Heaven." It is still true, but there is no longer the same risk that the exceptional man will be forthcoming, and you must not imagine that I am regarding him merely as one who will occupy a University Chair. He will be found more frequently in industry, where his function will be to hand on the ideas inspired by his genius to the ordinary investigator.

I have no intention of wearying you by elaborating my views on the training required to produce these different types. My task is greatly simplified if you will agree that the first step must be systematic experience in pure and disinterested research, without any reference to the more complicated problems of applied science. This is necessary, for if our technical research is to progress on sound lines the foundations must be truly laid. I have no doubt as to the prosperity of scientific industries in this country so long as we avoid hasty and premature specialisation in those who control them. We may take it that in the future the great majority of expert chemists will pass through a stage in which they make their first acquaintance with the methods of research under supervision and guidance. The movement is already in progress. The Government grants are awarded generously and widely. The conditions attached are moderate and reasonable, and there is a rush to chemical research in our colleges. Here, then, I issue my first note of warning, and it is to the professors. It is an easy matter to nominate a research student; a research laboratory comfortably filled with workers is an inspiring sight, but there are few more harassing duties than those which involve the direction of young research chemists. No matter how great their enthusiasm and abilities, these pupils have to be trained, guided, inspired, and this help can come only from the man of mature years and experience. I am well aware that scorn has been poured on the idea that research requires training. No doubt the word is an expression of intellectual freedom, but I have seen too many good investigators spoiled and discouraged through lack of this help to hold any other opinion than that training is necessary. I remember, too, years when I wandered more or less aimlessly down the by-paths of pointless inquiries, and I then learned to realise the necessity of economising the time and effort of others.

The duties of such a supervisor cannot be light. He must possess versatility; for although a "research school" will doubtless preserve one particular type of problem as its main feature, there must be a sufficient variety of topics if narrow specialisation is to be avoided. Remember, also, that there can be no formal course of instruction suitable for groups of students, no common course applicable to all pupils and all inquiries. Individual attention is the first necessity, and the educative value of early researches is largely derived from the daily consultations at the laboratory bench or in the library. The responsibility of becoming a research supervisor is great, and, even with the best of good will, many find it difficult to enter sympathetically into the mental position of the beginner. An unexpected result is obtained, an analysis fails to agree, and the supervisor, out of his long experience, can explain the anomaly at once, and generally does so. If the pupil is to derive any real benefit from his difficulties, his adviser must for the moment place himself in the position of one equally puzzled, and must lead his collaborator to sum up the evidence and arrive at the correct conclusion for himself. The policy thus outlined is, I believe, sound, but it makes severe demands on patience, sympathy, and, above all, time.

Research supervision, if conscientiously given, involves the complete absorption of the director's energy and leisure. There is a rich reward in seeing pupils develop as independent thinkers and workers, but the supervisor has to pay the price of seeing his own research output fade away. He will have more conjoint papers, but fewer individual publications, and limitations will be placed on the nature of his work by the restricted technique of his pupils.

I have defined a high standard, almost an ideal, but there is, of course, the easy alternative to use the technical skill of the graduate to carry out the more laborious and mechanical parts of one's own researches, to regard these young workers as so many extra pairs of hands. I need not elaborate the outcome of such a policy.

There is another temptation, and that, in an institution of university rank, is for the professor to leave research training in the hands of his lecturers, selecting as his collaborators only those workers who have passed the apprenticeship stage. This, I am convinced, is a mistake. Nothing consolidates a research school more firmly than

the feeling that all who labour in its interests are recognised by having assigned to them collaborators of real ability.

I am not yet done with the professor and his staff, for they will have other matters to attend to if research schools are to justify their existence and to do more than add to the bulk of our journals. In many cases it will be found that the most gifted of the young workers under their care lack what, for want of a better expression, is known as "general culture." Remember, these graduates have just emerged from a period of intensive study in which chemistry and the allied sciences have absorbed most of their attention. For their own sake and in the interests of our subject, they must be protected from the criticism that a scientific education is limited in outlook and leads to a narrow specialism. The research years are plastic years, and many opportunities may be found in the course of the daily consultations "to impress upon the student that there is literature other than the records of scientific papers, and music beyond the range of student songs." I mention only two of the many things which may be added to elevate and refine the research student's life. Others will at once occur to you, but I turn to an entirely different feature of research training, for which I make a special plea: I refer to the inculcation of business-like methods. You will not accuse me, I hope, of departing from the spirit of scholarship or of descending into petty detail, but my experience has been that research students require firm handling. Emancipated as they are from the restrictions of undergraduate study, the idea seems to prevail that these workers ought to be excused the rules which usually govern a teaching laboratory, and may therefore work in any manner they choose. It requires, in fact, the force of a personal example to demonstrate to them that research work can be carried out with all the neatness and care demanded by quantitative analysis. Again, in the exercise of their new freedom young collaborators are inclined to neglect recording their results in a manner which secures a permanent record and is of use to the senior collaborator. As a rule, the compilation of results for publication is not done by the experimenter, and a somewhat elaborate system of records has to be devised. It should be possible, twenty years after the work has been done, to quote the reasons which led to the initiation of each experiment, and to trace the

source and history of each specimen analysed, or upon which standard physical constants have been determined. I need not enter into detail in this connection beyond stating that, although a system which secures these objects has for many years been adopted in St. Andrews, constant effort is required to maintain the standard.

One of the greatest anxieties of the research supervisor is, however, the avoidance of extravagance and waste. The student is sometimes inclined to assume a lordly attitude and to regard such matters as the systematic recovery of solvents beneath his notice. My view is that, as a matter of discipline as much as in the interests of economy, extravagant working should not be tolerated. There is naturally an economic limit where the time spent in such economies exceeds in value the materials saved, and a correct balance must be adjusted. It is often instructive to lay before a research worker an estimate of the cost of an investigation in which these factors of time and material are taken into account. As a general rule it will be found that the saving of material is of greater moment than the loss of time. The point may not be vitally important in the academic laboratory, but in the factory, to which most of these workers eventually migrate, they will soon have the lesson thrust upon them that their time and salary bear a small proportion to costs of production.

You will see I have changed my warning from the professor to the student. A student generation is short. In a few years, when almost as a matter of course the best of young chemists will qualify for the Doctor of Philosophy degree, it will be forgotten that these facilities have come to us, not as a right, but as a privilege. Those who reap the advantages of these privileges must prove that the efforts made on their behalf have been worth while.

Looking at the position broadly, if one may criticise the research schemes of to-day, it is in the sense that the main bulk of support is afforded to the research apprentice, and the situation has become infinitely harder for the supervisor in that new and onerous tasks are imposed upon him. To expect him to undertake his normal duties and, as a voluntary act, the additional burden of research training is to force him into the devastation of late hours and overwork. The question is at once raised: Are we using our mature research material to the best advantage, and is our policy

sufficiently focussed on the requirements of the experienced investigator? I think it will generally be agreed that members of the professor or lecturer class who join in the movement must be relieved in great measure of teaching and administrative work. I am decidedly of the opinion that the research supervisor must be a teacher, and must mingle freely with undergraduates, so as to recognise at the earliest possible stage the potential investigators of the future and guide their studies. To meet this necessity universities and colleges must realise that their curriculum has been extended and that staffs must be enlarged accordingly. There could then be definite periods of freedom from official duties for those who undertake research training as an added task. Opportunities must also be given to these "exceptional men" to travel occasionally to other centres and refresh themselves in the company of kindred workers. It is evident that our universities are called upon to share the financial burden involved in a National Research scheme to a much greater extent than possibly they know.

I may perhaps summarise some of the conclusions I have reached in thinking over these questions. The first and most important is that in each institution there should be a Board or Standing Committee entrusted with the supervision of research. The functions of such a body would be widely varied and would include:—

1. The allocation of money voted specifically from university or college funds for research expenses.

2. The power to recommend additions to the Teaching Staff in departments actively engaged in research.

3. The recommendation of promotions on the basis of research achievement.

4. The supervision of regulations governing higher degrees.

Among the more specific problems which confront this Board are the following:—

1. The creation of Research Libraries where reference works can be consulted immediately.

2. The provision of publication grants, so that where no periodical literature is available the work will not remain buried or obscure.

3. The allocation of travelling grants to enable workers to visit libraries, to inspect manufacturing processes, and to attend meetings of the scientific societies.

I have dealt merely with the fringe of the question, but would add that there is

one thing which a Research Board should avoid.

It is, I am convinced, a mistake for a governing body to call for an annual list of publications from research laboratories. Nothing could be more injurious to the true atmosphere of research than the feeling of pressure that papers must be published or the Department will be discredited.

What I have said so far may seem largely a recital of new difficulties, but they are not insurmountable, and to overcome them adds a zest to life. It would have taken too long to go more fully into details, and I have tried to avoid making my address a research syllabus, merely giving in general terms the impressions gained during the 20 years in which the St. Andrews Research Laboratories have been in existence.

Save for the fact that I realise my audience is not confined to university teachers I would have liked to speak on some such points as these: The choice of a research student, the selection of a research subject, the writing of scientific papers. Each would demand a lengthy discussion, as would also the painful situation created when a research topic fails or a research worker proves disappointing.

I have confined myself to the first stage in the research development of the chemist. His future path may lead him either to the factory or to the lecture-room, and in the end the exceptional man will be found in the director's laboratory or in the professor's chair. However difficult these roads may prove, I feel that with the financial aid now available, supported by the self-sacrificing labours of those who devote themselves to furthering this work, he has the opportunity to reach the goal. It is the beginning of a new scientific age, and we may look forward confidently to the time when there will be no lack of trained scientific intellects to lead our policy and direct our efforts in all that concerns the welfare of the country.

(To be Continued.)

[Contribution from the Department of Chemistry, University of Wisconsin.]

SELENIUM OXYBROMIDE.

By VICTOR LENHER.

From the "Journal of the American Chemical Society."

The oxybromide of selenium, SeOBr_2 , was originally prepared by Schneider.¹ It

was later made by Glauser² who noted a few of its properties.

The various methods used for its preparation and its properties in general are closely related to those of selenium oxychloride.

Preparation.—One of the simplest and most direct procedures to assure a satisfactory product is to unite pure dioxide and pure tetrabromide of selenium.³ To this end, we have used freshly sublimed selenium dioxide, special care being taken to obtain it as dry as possible.⁴ To this is added the calculated amount of powdered fused pure selenium. The operation can be conveniently conducted in a glass flask closed by a rubber stopper carrying a dropping funnel and a tube containing freshly ignited pure calcium bromide to protect the products from atmospheric moisture. The requisite amount of pure bromine is added through the dropping funnel in small portions at a time. The heat evolved in the bromination of elementary selenium to monobromide and subsequently to tetrabromide is so great that it is advisable to chill the flask nearly to 0° in order to prevent loss of bromine. The heat evolved in bromination of the monobromide to the tetrabromide is so much less than in the production of the monobromide that the last portions of bromine can be added very rapidly. After the calculated amount of bromine has been added the mixture of tetrabromide and dioxide is gently warmed until all of the dioxide has dissolved to form oxybromide. When the selenium dioxide is finely powdered this takes place quickly, but when large crystals are used a number of hours may be required to effect complete solution.

Physical Properties.—Selenium oxybromide is a reddish-yellow solid that melts at 41.5–41.7° and boils at 217° under 740 mm. pressure with considerable decomposition. Its decomposition at even slightly elevated temperatures is so great that it has not been found practical to attempt to purify it by distillation under diminished pressure. Its density at 50° is 3.38. Its electrical conductivity, as observed by A. P. Julien in this laboratory in a modified Washburn cell using platinum electrodes

2 Glauser, *Z. anorg. Chem.*, 80, 277 (1913).

3 Lenher, *Jour. Amer. Chem. Soc.*, 42, 2498 (1920); 33, 29 (1921); 44, 1664 (1922).

4 *Ibid.*, p. 1664.

1 Schneider, *Pogg. Ann.*, 129, 459 (1866).

and working just above the melting point, 45-50°, is approximately 6×10

Selenium oxybromide is hydrolysed by water into selenious and hydrobromic acids. It dissolves readily without apparent chemical action in carbon disulfide, chloroform, benzene, toluene and xylene, and the fused material is miscible in all proportions with these solvents, as is selenium oxychloride.

Carbon tetrachloride dissolves selenium oxybromide but the fused substance is soluble to the extent of only about 6 per cent. Carbon tetrachloride and selenium oxybromide do not immediately react chemically when brought into contact, but when heated together for several days phosgene is produced in large quantities.

With the saturated aliphatic hydrocarbons there is apparently little if any chemical action. The pure hydrocarbons hexane, heptane, octane and decane are immiscible with the reagent. The lighter hydrocarbons float on melted selenium oxybromide. Similarly, melted paraffin or vaseline floats on liquid selenium oxybromide.

CHEMICAL PROPERTIES.

Selenium oxybromide is a very active chemical reagent. Its deportment and activity in general much resemble those of the oxychloride. When selenium oxybromide is distilled it dissociates somewhat into selenium dioxide and tetrabromide. Heating the tetrabromide causes further decomposition into monobromide of selenium and free bromine. It is possible to distil the substance, but there is considerable loss in the operation. Even when distilled under greatly diminished pressure there is considerable decomposition. In order, therefore, to avoid confusion of the behaviour of selenium oxybromide with the various materials studied, comparative experiments have been made with the particular substances and bromine.

Action on Non-Metals.—The members of the sulfur group, sulfur, selenium and tellurium, react immediately with selenium oxybromide. Sulfur even in the cold with solid selenium oxybromide liquefies in a few minutes and evolves sulfur dioxide with effervescence. Selenium dissolves in large quantities in melted selenium oxybromide forming the monobromide. Tellurium reacts in the cold but not so energetically.

White phosphorus with solid selenium oxybromide explodes violently, while red phosphorus with solid selenium oxybromide takes fire and burns with a flame.

Iodine dissolves in large quantities in selenium oxybromide, while chlorine displaces the bromine and converts it to pure selenium oxychloride. Crystalline silicon is unattacked by the reagent even at 217°. Carbon in all forms, graphite, charcoal, activated carbon and diamond are not attacked even at its boiling point by selenium oxybromide.

Action on Metals.—Selenium oxybromide reacts with most of the metals forming the bromide and selenium monobromide. Sodium reacts in the cold with selenium oxybromide with slight explosion evolving light and heat. Potassium in the cold with solid selenium oxybromide explodes violently.

Metallic mercury, arsenic, antimony, tin, bismuth, iron, calcium, copper, lead, silver, molybdenum, thallium, gold, platinum and zinc are attacked by selenium oxybromide. Zinc dust burns beautifully in selenium oxybromide, making a striking experiment. Aluminum and magnesium are only very slightly corroded by heating in a sealed tube with selenium oxybromide for a week at 100°. Chromium, cadmium, nickel, cobalt, tungsten and tantalum are not attacked when heated with selenium oxybromide in a sealed tube for 10 days to 100°.

Action on Oxides.—Selenium oxybromide reacts with certain of the oxides, such as mercuric oxide, silver oxide, lime and sodium peroxide with great energy, while arsenic trioxide, tin dioxide, tellurium dioxide, tellurium trioxide react more slowly and less energetically.

Such oxides as those of columbium, tantalum, vanadium, thorium, titanium, zirconium, uranium, and antimony are apparently unaffected even on heating in a sealed tube for a number of days to 100°. Ignited cerium oxide is only very slightly attacked.

Carbonates.—Selenium oxybromide reacts slowly and sluggishly with the carbonates of calcium, strontium, barium, magnesium, lead, copper, sodium, potassium and the alkaline bicarbonates, even when warmed. When water is present the action is, of course, vigorous. Dry cobalt carbonate is not appreciably acted upon.

Sulfides.—Arsenious, arsenic, antimonious, stannous, cadmium, zinc, bismuth, mercuric, lead, strontium, and ferrous sulfides react with selenium oxybromide, evolving heat. The metallic bromides and selenium monobromide are formed. Pyrite,

marcasite, arsenopyrite, and tetrahedrite react with selenium oxybromide with production of selenium monobromide.

Calcium Hydride, Carbide and Phosphide are only very slowly and sluggishly attacked by selenium oxybromide even on boiling.

Barium Sulfate is not acted on by selenium oxybromide nor is it rendered colloidal as is the case when brought in contact with selenium oxychloride.

Oxidizing Agents.—Potassium chlorate reacts with selenium oxybromide and bromine is evolved. When the two are gently warmed together the bromine is completely expelled in a few minutes. Potassium perchlorate does not react with selenium oxybromide.

Potassium permanganate, potassium dichromate and chromium trioxide do not react with selenium oxybromide, even on boiling.

Jour. Amer. Chem. Soc. 43, 32 (1921).

Action of Various Gases.—When dry air is bubbled through pure selenium oxybromide heated to 60°, bromine is gradually driven off. This is due to a primary dissociation of the oxybromide into dioxide and tetrabromide of selenium and to a secondary slow decomposition of the tetrabromide into monobromide and free bromine which is volatile. After dry air is bubbled through heated pure selenium oxybromide for several days and the resulting product treated with water, a very large amount of monobromide appears as the characteristic heavy red-brown liquid which hydrolyzes very slowly. Indeed, the slow hydrolysis of selenium monobromide is one of its striking features. Selenium monobromide is only slowly decomposed by boiling water into elementary selenium, selenious and hydrobromic acids, while when allowed to stand with excess of cold water some of the liquid selenium monobromide remains undecomposed at the end of several days.

Dry Sulfur Dioxide and Dry Carbon Monoxide do not react with fused selenium oxybromide. *Hydrogen Sulfide* causes slight decomposition.

Hydrocarbons.—The saturated aliphatic hydrocarbons are only slowly attacked by selenium oxybromide at a high temperature.

The unsaturated aliphatic hydrocarbons react with selenium oxybromide with great energy. Amylene, turpentine and isoprene react with great violence with selenium oxybromide.

The aromatic hydrocarbons such as benzene, toluene, and xylene form physical mixtures with selenium oxybromide from

which the hydrocarbons can be recovered by hydrolysis of the mixture with water.

Naphthalene, anthracene, phenanthrene and retene dissolve readily in selenium oxybromide with chemical change.

Separation of the Hydrocarbon Series by Selenium Oxybromide.—It is possible to separate the various hydrocarbon series from one another. Benzene and toluene dissolve in selenium oxybromide and can be separated from such hydrocarbons as heptane which is immiscible with selenium oxybromide and is immiscible with a solution of the benzene or toluene in the oxybromide. The lighter heptane floats. Such unsaturated hydrocarbons as amylene can also be separated from heptane by selenium oxybromide. Naphthalene and heptane are readily separated by this reagent.

Carbohydrates and Proteins.—Selenium oxybromide when just melted dissolves with ease such proteins as hair, silk, leather, gliadin from wheat, zein from corn, glutenin from wheat, elastin, gelatin, blood albumen and egg albumen.

Its action on cellulose is not appreciable. The melted substance can be filtered through filter paper, as has been frequently done in this laboratory.

Vegetable and Fish Oils.—The action of selenium oxybromide toward the vegetable and fish oils is similar to the behaviour of sulfur monochloride or selenium oxychloride. With oils having a high iodine number the action is vigorous, while with the oils which are of a more saturated character the action is more moderate. The oils are changed into a rubber-like mass which contains selenium and bromine. The oils examined were raw and boiled linseed, china wood, soy bean, corn, cotton, sesame, peanut, castor, olive, palm, coconut, menhaden, cod liver, whale, sperm, lard and neat's foot oil.

The "Insoluble" Phenolic condensation products, Redmanol and Bakelite, dissolve readily in melted selenium oxybromide. The reaction is accelerated by heat. The substances are changed chemically.

Gums, resins, dried paints, lacquers, baked organic enamels, glues, and insoluble casein glues dissolve readily in melted selenium oxybromide. Saturated substances such as ozocerite form 2-component systems in which the lighter melted substance floats on the heavier selenium oxybromide layer.

Coals and Carbons.—When melted selenium oxybromide is brought into contact with coals of the bituminous variety,

reaction takes place with the resinic and bituminous parts of the coal, solution of a part of the coal is effected, and at the same time an insoluble carbonaceous residue is left behind.

Anthracite coal containing no volatile combustible matter is unaffected, as are thoroughly ignited coke and graphite.

Amorphous forms of carbon containing hydrocarbons lose their hydrocarbon content when treated with selenium oxybromide. Thus, ordinary lampblack yields a black extract with melted selenium oxybromide, leaving behind carbon.

Activation of Charcoal by selenium oxybromide can be accomplished readily. "Retorted" nut carbon when treated with melted selenium oxybromide loses hydrocarbons and actually effervesces in the cold from the heating effect produced in the chemical reaction.

Similarly, a solution of selenium oxybromide in carbon tetrachloride or benzol, extracts hydrocarbons from "unactivated" nut charcoal, leaving behind activated carbon which does not react with selenium oxybromide.

Acknowledgment is hereby made of the valuable aid rendered in various parts of this work by my research assistant, C. W. Muehlberger.

SUMMARY.

Selenium oxybromide is a reddish-yellow solid melting at 41.5-41.7°.

It can readily be prepared by any reaction in which pure selenium dioxide and tetrabromide are brought in contact.

When heated, selenium oxybromide slowly begins to dissociate just above its melting point, while at higher temperatures the dissociation is so great that it is impracticable to use distillation, even under reduced pressure, as a means of purification.

Its chemical properties are similar to those of the oxychloride.

In liquid form, above 42°, it is a powerful solvent, deporting itself in general as an oxidizing and brominating agent.

Madison, Wisconsin.

THE PREPARATION OF FRUCTOSE.

T. SWANN HARDING.

As inulin gives only fructose on hydrolysis, it is an ideal starting point for the preparation of this sugar, but owing to its

comparative scarcity, sucrose has been used in this research. 2,000 gm. of sucrose are dissolved in 6,000 cc. distilled water, and the optical activity of the solution measured. The solution is next inverted by means of invertase. Complete inversion is brought about when the Ventzke reading is one-third of the original optical activity but negative instead of positive. The liquid is then treated with a little decolorising carbon, filtered and evaporated to a thick syrup under vacuum. This is now mixed with twice its volume of hot glacial acetic acid, cooled and "seeded" with glucose. After 3-4 days the glucose crystals are filtered off, washed with glacial acetic acid and dried *in vacuo*.

The filtrate containing the fructose is diluted with water and concentrated *in vacuo* and repeatedly so treated to remove the acetic acid. When very syrupy an equal volume of hot glacial acetic acid is added, the liquid cooled, and "seeded" with fructose. After 2-3 days, the fructose crystals are filtered, washed with glacial acetic acid and dried in a vacuum. The yield is 23 to 28 per cent. of the weight of sucrose taken. The sugar is recrystallised from hot alcohol and when decolorised and twice recrystallised the fructose will have a specific rotation of $[\alpha]_D^{20} = -92$. (*Jour. Amer. Chem. Soc.*, 1922, p. 1765.)

YIELD OF GLUCOSE FROM COTTON CELLULOSE.

J. C. IRVINE AND E. L. HIRST.

The cotton cellulose used contained 6.7 per cent. moisture, 0.14 per cent. mineral ash, 0.07 per cent. oil, 2.47 per cent. soluble in 3 per cent. caustic soda, and had a copper reduction figure of 0.37 per cent. From this, cellulose triacetate was prepared by soaking in glacial acetic acid and passing through it a stream of dry chlorine gas for 30 seconds. After standing, more acetic acid was added, and SO₂ passed through the liquid, and the whole allowed to stand for an hour, and the temperature raised to 65°. The clear solution was cooled, chloroform added, and then an excess of water. The chloroform was next evaporated off, when the acetate separated out and was washed free from acid and dried. The composition was found to agree with C₆H₇O₄(CH₃CO)₃. This triacetate

was next hydrolysed and condensed with methyl alcohol in one operation by heating it with methyl alcohol and a very little hydrogen chloride in a sealed tube at 125° C. The resulting methyl glucosides were recovered by neutralising, decolorising and evaporating the liquid under reduced pressure and crystallising from a little hot alcohol. The crystals had M.P. 125–150° C., and were an equilibrium mixture of α and β methylglucoside. The scheme of the work is to convert the cellulose into cellulose triacetate (99.5 per cent. yield), and to transform this into the methyl glucosides corresponding to a yield of 95.1 per cent. of glucose. It is considered that cotton cellulose consists entirely of glucose residues.—(*J.C.S., 1922, Trans., p. 1585.*)

THE MULTI-BROMO-NAPHTHALENES OF FROM FOUR TO SIX ATOMS OF BROMINE AND OTHER HALOGEN-COMPOUNDS OF THE SAME GROUP.

By JOHN MISSENDEN.

With regard to the compounds of this heading, most of which form themselves under isomeric groups, it will be especially noted that they are entirely composed of eighteen atoms of matter, ten of which are always carbon, the other eight being hydrogen and one or two of the halogens. The grading of the compounds, therefore, depends upon the displacement of hydrogen as the numerical value of the halogens increases.

Of the compounds containing but four atoms of bromine, α -tetrabromonaphthalene (1:4:3':2') is foremost, the other being the β -compound. α -Tetrabromonaphthalene takes the form of elongated pyramids (which, on becoming anhydrous, assume a flat prismatic shape) which melt at 191.3° C. It may be prepared by treating β -dibromonaphthalene-tetrabromide, $C_{10}H_6Br_2Br_4$, with sodium ethylate dissolved in alcohol, and will produce dibromophthalide and tetrabromo- α -naphthoquinone if subjected to a solution of chromium trioxide in acetic acid. β -Tetrabromonaphthalene possesses similar properties to the α -compound, except that it is readily soluble in ether, whereas the other is scarcely soluble. Both are soluble in al-

cohol, but insoluble in water. The β -compound fuses at 127° C., and is produced, together with its isomer,¹ from α -dibromonaphthalene-tetrabromide.

The pentabromo-compound, like the hexbromo-compound, has only one known form. Its formula is $C_{10}H_3Br_5$; and it has a granular appearance, is colourless, and is insoluble in alcohol. It may be produced by mixing α -tetrabromonaphthalene with bromine and heating the mixture to 165.3° C. Hexbromonaphthalene, $C_{10}HBr_6$, has a pyramoid form which, on becoming anhydrous at 232.8°–233.3° C. is transformed into flat prismoids. It is slightly soluble in benzene² and chloroform, and totally insoluble in ether, alcohol and water. It may be prepared by mixing four parts of naphthalene with three parts of bromine and one of iodine, and heating the whole to 310° C.

Many compounds of the bromo-chloro-order are known, most of which were discovered by Laurent, but only the simple bromochloronaphthalene and its three isomeric forms will come within the scope of this paper. Bromochloronaphthalene, $C_{10}H_6BrCl$, has the α -form, β -form, and γ -form. The α -compound (Cl:Br=4':1) is a pyramid-crystalline substance which fuses at 116.7° C.³ It is formed by submitting α -bromonaphthalene-sulphochloride to the action of phosphorus pentachloride. The β -compound crystallises in flat prismatic shapes, and may be prepared, together with the γ -compound, by either treating α -chloronaphthalene with bromine or treating α -bromonaphthalene with chlorine. On oxidation, chlorophthalic acid appears. Both the α - and β -compound are almost insoluble in alcohol. The γ -compound is anhydrous and is similar in form to the β -compound. It fuses at 64.8° C., boils at 308° C., and is soluble in alcohol. It yields bromochlorophthalide on oxidation.

1 Roscoe and Schorlemmer.

2 Gessner; *Ber. Deutsche. Chem. Ges.*; 9 1510.

3 According to Clerc (*Bull. Soc. Chim.*; 26, 540) the figure is 115° C., both results being at N.T.P.

GENERAL NOTES.

**THE SIR JOHN CASS TECHNICAL
INSTITUTE, JEWRY STREET,
ALDGATE, E.C.3.**

The new session of the Sir John Cass Technical Institute, Aldgate, E.C.3, will commence on Monday, September 25th. Students will be enrolled during the previous week, commencing Monday, September 18th, between 6.30 and 8.30 p.m.

The courses of instruction at the Institute meet the requirements of those engaged in chemical, metallurgical, electrical, petroleum, and the fermentation industries. Full facilities are provided in the well-equipped laboratories of the Institute for special investigations and research. The instruction in experimental science also provides systematic courses for the examinations of London University and of the Institutes of Physics and Chemistry.

Special courses of higher technological instruction form a distinctive feature of the work of the Institute, and for the forthcoming session these include Brewing, Malting, Micro-Biology, Petroleum Technology, Colloids, Alternating Currents and Electrical Oscillations, Mathematical Statistics, Metallography and Pyrometry, Heat Treatment and Mechanical Testing of Metals and Alloys, and Foundry Practice.

**RAMSAY MEMORIAL TABLET IN
WESTMINSTER ABBEY.**

H.R.H. the Prince of Wales, who is Patron of the Ramsay Memorial Fund, has consented to unveil on Friday, November 3rd, at 12 noon, the memorial tablet of the late Professor Sir William Ramsay, which is being placed in Westminster Abbey.

The tablet has been executed by Mr. Charles L. Hartwell, A.R.A. It was exhibited at the Royal Academy this summer.

Invitations will be sent out in October. Any communications with respect to the unveiling should be addressed to the Organising Secretary of the Ramsay Memorial Fund, Dr. Walter W. Seton, at University College, London, Gower Street, W.C.1.

**THE PASTEUR COMMEMORATION
FUND**

We are informed by Mr. A. Chaston Chapman, hon treasurer in this country for

the Pasteur Commemoration Fund, that the sum of £318 14s. 6d. has been subscribed, and that this amount has been forwarded to Monsieur Héring, the General Treasurer, with an intimation that should the amount prove more than the French Committee desire to expend upon the monument, the excess should be devoted to some other form of permanent memorial of Pasteur in the University of Strasbourg.

**THE USE OF BASIC SLAG AS A
FERTILISER.**

Bessemer basic slag, in suitable cases, has effected remarkable improvement in grassland, whether pasture or meadow. It produces its most striking results on heavy land covered with poor herbage containing large quantities of "bent grass," which goes brown in autumn, giving a very parched appearance to the field. The best known instance is that of Cockle Park, where grazing capable of carrying about $1\frac{1}{2}$ sheep per acre and producing only about 25 lb. of live weight increase per acre each season has been so improved that it now carries about $3\frac{1}{2}$ sheep per acre and produces about 100 lb. live weight increase.

The improvement is effected through the agency of the wild white clover, which begins to develop soon after the slag is applied. It is therefore essential that the conditions should favour this plant, and for this reason it is wise to adopt a bold policy and give a substantial dressing of slag at the outset. Where drainage is necessary this must receive attention, but there are instances where the wetness of the grass is due not so much to faulty natural drainage as to a mat of moss or decaying vegetation which impedes the soaking away of the water. In such cases the unslagged land may remain wet while on the slagged land the mat disappears and the water gets away naturally.

It is sometimes supposed that slag acts well only if there is heavy rainfall, but this is shown not to be the case by the Essex experiments conducted by Prof. G. Scott Robertson. Although the rainfall is not particularly high, slag has improved the yield of hay, raising it from 10 cwt. per acre on the unmanured to 20 cwt. per acre on slagged land in one of the poorest fields, and from 30 cwt. on the unmanured to 40 cwt. per acre on the slagged land in one of the best fields. Here also the chief im-

provement is in the type of herbage: the clover increases considerably, and the land is more completely covered with vegetation, with the result that its temperature is lower in summer, there is less wastage of water by evaporation, and in consequence the crop has a larger available supply of water.

CANTHARIDIN BEETLES.

In the November, 1920, issue of the *Journal** there was published an article on mylabris beetles, a large group of which are generally known as "blister beetles," and which have a commercial value. These beetles are dried and reduced to a powder, from which is obtained a crystalline substance known as cantharidin. This is occasionally used internally in minute doses as a stimulant and diuretic, but its principal use is in solutions, tinctures, plasters, etc., where a strong irritant is required. The *Journal* article (which is illustrated) deals with the life-history of these beetles, their food habits, uses, methods of killing, collection and preparation, etc.

An effort is now being made by the Department of Mines and Industries (Industries Division) to establish a local industry in connection with *Mylabris oculata* beetles ("Spanish fly" or "Boontje Keever"), which are a source of cantharidin and are found in many parts of the Union. Technical reports obtained from London on a sample of South African mylabris beetles indicate that there is a likelihood of finding a market in the United Kingdom for them, but before anything more definite can be said on this point it will be necessary to forward a commercial sample to London. For this purpose, Mr. E. D. Punter, P.O. Lead Mine, Koster, Transvaal, is acting in co-operation with the Industries Division, and will be prepared to receive collections of mylabris beetles from anyone in a position to supply, and prepare them for shipment to England. Persons willing to assist in this matter should communicate direct with Mr. Punter, who will give them full particulars of the proper method of killing and packing the insects. He will also make payments for the beetles at the rate of 2s. 6d. per pound.

* *Journal of the Department of Agriculture, Union of South Africa.*



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs can be obtained gratuitously.

Latest Patent Applications.

- 221721—Atexandra, H. M. Separating liquids of different specific gravity. August 15.
- 22625—Bongough, G. D. Method of preserving aluminium and its alloys from corrosion. August 19.
- 22045—Clayton, W. C.—Manufacture of hydrogen peroxide. August 11.
- 22347—Douglas, R. P. Manufacture of sulphate of ammonia. August 17.
- 22243—Mond, A. L.—Chloridizing roasting of ores. August 15.
- 22455—Sim, D. J. Manufacture of lead carbonate. August 17.

Specifications Published This Week.

- 183897—Hadden, P. Process of converting organic acids into esters.
- 171391—Stockholm Superfosfat Fabriken Aktiebolag.—Method of manufacturing acetone from acetic acid.
- 184129—Bunmberke, J. Dehydration of alcohol.

Abstract Published This Week.

Extracting Glue.—Patent No. 181865.—A new process for extracting glue from raw materials containing gelatine and glue has been developed by Messrs. Plauson's (Patent Co.), Ltd., of 17, Waterloo Place, Pall Mall, London.

The material is subjected to high speed mechanical disintegration with water and preferably a small quantity of a substance rich in oxygen, in a mill, having a peripheral speed of not less than 1,000 metres per minute, such as is described in Specifications 176002, 176003, and 179124. The extraction may be carried out under a small steam pressure. The glue solutions thus obtained are then treated, preferably in a mill as described above, with a liquid immiscible with water, such as a chlorinated hydrocarbon, a paraffin, or other hydrocarbon, or mixtures such as ether with acetone or alcohol. The emulsification may be assisted by addition of small quantities of a water-soluble organic liquid. The emulsion obtained is either allowed to separate into two layers or the separation is accelerated by use of pressure, by addition of small quantities of a strong acid or salt thereof, by centrifuging or by osmotic means. One layer consists of a solution of fats, etc., in the organic solvent, and the other of a solution of glue in water. The second treatment with a solvent may be repeated if necessary. In examples of finely ground fish waste, waste hide or leather, and bones are treated with water and a small quantity of potassium permanganate or of sulphur dioxide in a colloid mill, and the solid impurities are removed by settling centrifugalization, or filtration. Ether, benzene, and trichloroethylene are mentioned as solvents for the fats, both the solvents and the fats and protein being recoverable. The glue is obtained by ordinary boiling and drying.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3258

THE INSTITUTE OF METALS.

ANNUAL MEETING, SWANSEA,
SEPTEMBER 20TH, 1922.

Summary of SIXTH REPORT TO THE CORROSION RESEARCH COMMITTEE OF THE INSTITUTE OF METALS on "THE NATURE OF CORROSIVE ACTION, AND THE FUNCTION OF COLLOIDS IN CORROSION," by GUY D. BENGOUGH, M.A., D.Sc., and J. M. STUART, M.A.

This Report attempts to present a general discussion of corrosion phenomena, based on the study of several different metals, and to examine how far the electro-chemical theory of corrosion usually called the electrolytic theory) can account for the observed phenomena. The difficulties encountered by this theory are indicated, and it is shown that it gives a satisfactory account of the facts only under certain conditions, while many facts can only be explained by recognising the important part played by colloids in corrosion. A theory of the mechanism of colloid action is put forward, and some experimental results are reviewed in the light of this theory.

The Report commences by defining the terms corrosion, chemical exfoliation, erosion, and scale, which are used somewhat loosely by some writers. Corrosion is defined in its widest sense as the oxidation of a substance. It is then pointed out that such oxidation may be produced by chemical or electro-chemical means, and these two types of reaction are defined. Chemical reactions may occur when the reacting bodies are in contact, electro-chemical reactions when the reacting bodies are spatially separated. In the latter case the reacting substances must be capable of ionization, and a portion of the energy of the system appears as electrical energy. Two cases of corrosion are considered, both of which can be carried out chemically or electro-chemically. Pure electro-chemical action may in certain cases be relatively unimportant. Thus the cathode of a cell of high voltage may be more rapidly attacked than the anode, while an anode at a high voltage tending to force it into solu-

tion may be very little corroded owing to scale formation.

Further facts which are difficult to explain on a purely electro-chemical theory are the following:

1. Certain depolarizers do not increase corrosion, but actually inhibit it.
2. The conductivity of electrolytes is not directly connected with the amount of corrosion.
3. Lambert's pure iron (probably the purest metal ever produced) was found to be readily attacked by sodium chloride solution and dilute acids.
4. According to the electro-chemical theory, the presence of ions of the corroding metal should depress the corrosion of most of the common metals. There are, however, numerous exceptions, and in some cases the presence of such ions actually increases corrosion.

The order of corrodibility of metals in distilled water, certain salt solutions, and non-electrolytes, is different from their order in the electro-chemical list, which suggests that there are factors interfering with the electro-chemical action. Such a factor is scale formation, and a main factor in determining the amount of corrosion by water and salt solutions is the nature and distribution of the products of corrosion. This may be far more important than any hypothetical distribution of cathodes and anodes in the metal.

The effects of strain and impurity in the metal are considered on the electro-chemical view to be of fundamental importance, and Lambert's pure iron and lead were prepared with a view to eliminating both these factors. Neither metal was incorrodible in certain conditions. However, potential differences between strained and unstrained portions of the same metal are usually very small, and unstrained (annealed) metal may corrode more rapidly than strained metal. In fact, the effect of strain is a minor and ephemeral factor in corrosion in neutral solutions.

As regards the effect of impurities on the corrosion of metals, a trace of impurity appears to assist local corrosion, but the amount of corrosion is not proportional to the amount of impurity. Even the presence of graphite does not appreciably stimulate the rate of corrosion of iron. The effect of a trace of impurity is probably a trigger action.

Local action at metallic surfaces may be produced in a variety of ways at any selected points by modifying the conditions external to the surfaces, and is not mainly determined by the presence of anodic areas on the metal. Minute pores in a metal may, however, give rise to local action, as has been shown by Seligman and Williams.

On the electro-chemical theory the action of oxygen is that of a depolarizer. It can be shown, however, that atmospheric oxygen has very little depolarizing power at ordinary temperatures. The main function of oxygen in corrosion is to oxidize directly the metal, and also in some cases the products of corrosion.

The effect of over-voltage on corrosion phenomena is briefly considered.

Two chief types of corrosion are distinguished: (1) The general type, usually characteristic of acid corrosion; (2) the local type, usually characteristic of corrosion in water and salt solutions. The second type is generally characterised by the formation of an adherent scale on the metal, and this scale may contain colloid.

A theory is developed regarding the part played by colloids in corrosion, and this theory may be briefly outlined as follows:

A metal immersed in water sends positively charged metal ions into the liquid, and becomes itself negatively charged. In the case of ordinary commercial metals, the metal also becomes superficially oxidized if dissolved oxygen is present. The hydroxide produced by this oxidation can take up the ions given off by the metal, and the hydroxide thereby passes into the state of a positively charged colloid. Some of this colloid will diffuse away, permitting further reaction between the oxygen and the metal surface, and thereby reforming the hydroxide film over the latter. Oxidation is then stopped till this hydroxide can pass into the colloidal state by acquiring positively charged metal ions. This, in general, does not take place till the colloid initially formed has diffused into the presence of electrolyte, when it is precipitated by the anion of the dissolved salt, the cation neutralising the charge on the metal corresponding to that on the colloid. This allows the metal to send more ions into solution, and the uncharged hydroxide thereby acquires a charge. If the colloid so produced can diffuse away, the process can continue and corrosion develop.

For steady corrosion, therefore, the colloid must be produced under conditions which allow it to diffuse some distance from the metal before precipitation. If it precipitates directly on the corroding surface, it will, in general, adhere to the latter and stop corrosion. In the case of a corrosion pit, the first condition is fulfilled, since no precipitation occurs inside the pit. It is only when the colloid diffuses through an aperture (generally very small), in the gel-deposits at the mouth of the pit, that it meets electrolyte and is then precipitated. Such precipitation merely thickens the external gel-deposits. These gel-deposits adhere directly to and protect the metal surrounding the pit, and thereby emphasise the local nature of the corrosion.

Summary of Note on "THE EFFECT OF SUPERHEATED STEAM ON NON-FERROUS METALS USED IN LOCOMOTIVES," by SIR HENRY FOWLER, K.B.E., presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, on Wednesday, 20th September, 1922.

Superheated steam is now very generally used on locomotives, the steam usually leaving the superheater at a temperature of 340° C. Not all the parts mentioned are subjected to this continuously, as the steam expands, and in so doing falls in temperature. The practice referred to is that adopted on the Midland Railway.

Piston Tail Rod Bushes.—These were originally made of:—

	per cent.
Copper	87
Tin	9
Zinc	2
Lead	2 called M.R.A. — 1 alloy.

but this was found to break in service. The cast iron which replaced it was found to score the rods, but a phosphor bronze of the following composition has been found to be satisfactory:—

	per cent.
Copper	88
Tin	11
Phosphorus	1

Piston Rod Packing.—McNamee rings of the following composition:—

	per cent.
Copper	75.5
Tin	8.5
Zinc	0.33
Phosphorus	trace
Nickel	0.5
Lead	15.0

are used satisfactorily. These rings are to prevent the steam coming into contact with the white metal packing rings, of the following composition:—

	per cent.
Lead	70
Antimony	30

Recently when the temperature of the steam leaving the superheater has been as high as 425° C. trouble has been experienced with the packing rings fusing. The full heat is only on these parts intermittently.

Piston Valve Fittings and Cylinder Relief Valves.—These have been made of alloy M.R.A. 1 and have acted satisfactorily.

By-Pass Valves.—These are subjected to shock; and good quality cast iron, gun-metal of M.R.A. 1 alloy, and phosphor bronze, as tried in tail rod bushes, were found unsatisfactory. A complex nickel-brass, however, gave good service, but in view of the expense were replaced by malleable iron or steel castings

Summary of Paper on "WHITE METALS," by A. H. MUNDLEY, C. C. BISSETT, B.A., B.Sc., B.MET., and J. CARTLAND, M.C., M.Sc., presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, on Wednesday, September 20th, 1922.

The authors review the manufacture and use of white metal for industrial purposes.

The composition, mechanical and physical properties of the chief alloys are given. Their constitution and microstructure are dealt with only so far as the uses and manufacture are concerned.

The chief representative grades of anti-friction or bearing metal are described, the application of appropriate alloys for particular purposes being indicated.

The effect of overheating or injudicious handling is described. Considerable attention is given to the preparation and properties of the various classes of printing alloys. The characteristics of each grade

being given, the necessities of the printer and method of employment so far as these alloys are concerned are discussed.

Brief references are made to die casting alloys, metals for chemical works' castings, solders, etc.

The paper is illustrated by photo-micrographs and prints.

Summary of Paper on "GRAIN-SIZE AND DIFFUSION," by PROFESSOR J. H. ANDREW, D.Sc., and ROBERT HIGGINS, presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, on Wednesday, September 20th, 1922.

Experiments have been conducted which show the relation between grain growth and diffusion. Diffusion at high temperatures may take place simultaneously with grain-growth, whilst at low temperatures diffusion promotes a breakdown in the grain-size. These results have been applied to the annealing treatment of commercial castings. A suggestion has been advanced to explain the atomic arrangement existing at the grain boundary. It has been assumed that in the interior of the crystalline grains the system of closest packing holds, whilst at the boundaries the atoms in the separate grains touch only at one part of the circumference. This explains the decrease in specific gravity with an increase in the number of grains, for in such an arrangement certain free spaces must occur. Plastic deformation, by shifting the atoms in certain grains from their position of equilibrium, will cause these atoms to rearrange themselves when heated to a sufficiently high temperature; this rearrangement will be so brought about that the stressed atoms will fall in with, row for row, the unstressed atoms of the adjacent crystal, thereby effecting a gradual migration of the grain boundary. Such a rearrangement may proceed from every side of a crystalline unit, resulting in one grain being divided up and being absorbed by others. The final bounding surface will result when a state consistent with that suggested for the boundary configuration finally results. A suggestion based upon the Langmuir idea of valency has been given to explain the migration of a separating phase to the grain boundary.

Summary of a REPORT TO THE ALUMINIUM CORROSION RESEARCH SUB-COMMITTEE OF THE CORROSION RESEARCH COMMITTEE OF THE INSTITUTE OF METALS on "EXPERIMENTS ON THE OXIDE METHOD OF DETERMINING ALUMINIUM," by J. E. CLENNELL, B.Sc., presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, on Thursday, September 21st, 1922.

The object of the investigation described in this Report was to find a direct method of determining aluminium in presence of iron and other impurities. The phosphate method was rejected, as it had been found that the precipitates obtained showed varying proportions of alumina and phosphoric acid. The ammonia method of precipitating aluminium as hydroxide was likewise rejected owing to the difficulties of filtering and washing the precipitate and obtaining it free from impurities.

Experiments were made on the methods described by previous investigators, in which aluminium is precipitated as hydroxide by alkali nitrites, by phenylhydrazine, and by a mixture of iodide and iodate of potassium, but more satisfactory results were obtained by precipitation with alkali thiosulphates.

It was found in nearly all cases that the weight of precipitate exceeded the theoretical amount calculated from the aluminium known to be present. This excess was traced to the presence of small quantities of absorbed substances, notably salts of iron and sulphates, probably of aluminium, which could not be removed by prolonged washing. Substitution of ammonium thiosulphate for the usually employed sodium salt did not reduce the excess.

A method was finally evolved whereby iron was practically eliminated and other impurities reduced to a minimum. This consists in passing sulphur dioxide through the slightly ammoniacal solution, precipitating in dilute, faintly acid, boiling solution with sodium thiosulphate with addition of dilute acetic acid, washing by decantation with hot 1 per cent. ammonium chloride, filtering and washing with hot water. Iron, zinc, manganese and magnesium in ordinary amounts do not interfere, but when the first two are present in large quantity a double precipitation is necessary. The method was successfully

applied in experimental work carried out for the Corrosion Research Committee on the oxidation of aluminium amalgam.

Summary of Paper on "THE CONSTITUTION AND AGE-HARDENING OF ALLOYS OF ALUMINIUM WITH COPPER, MAGNESIUM, AND SILICON IN THE SOLID STATE," by MARIE L. V. GAYLER, M.Sc., presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, on Thursday, September 21st, 1922.

Constitution of the Alloys.—The quaternary system of alloys containing aluminium, copper, magnesium and silicon has been regarded as the ternary system aluminium-copper-magnesium silicide, since magnesium and silicon were added in the proportions of the compound magnesium silicide, which is very stable at all temperatures.

The solubilities of copper and magnesium silicide in solid aluminium were determined at 500° C. and 250° C., and microscopic examination showed that the solubility of copper was reduced from 4.5 per cent. to 2 per cent. at 500° C. by the presence of 0.7 per cent. magnesium silicide; while 2 per cent. of copper reduced the solubility of magnesium silicide from 1.2 per cent. to 0.7 per cent. at 500° C. At 250° C. both constituents are turned out of solution when only 0.5 per cent. of each are present.

Age - Hardening. — Brinell hardness measurements were made on alloys in which the percentage content of one constituent was fixed while the other was varied, and which had been quenched from 500° C. and allowed to age-harden at room temperature. The results showed that the age-hardening of these alloys is due to the difference in solubility at high and low temperatures of both copper and magnesium silicide. The maximum amount of age-hardening which it is possible to obtain from such alloys depends on the solubility in aluminium of both constituents in the presence of each other. Further heat treatment of these age-hardened alloys, at temperatures higher than room temperature, caused a preliminary softening before an increase in hardness; this is probably due to the process by which both compounds tend to come out of solution.

Derived differential curves of alloys which had been quenched, but not aged, show three critical points; the lowest point takes place at constant temperature, while the temperature of the two upper critical points is lowered with increasing copper content; also the intensity of the uppermost point varies in a marked degree with the copper content. It is suggested that this point is due to the precipitation of the copper compound, and the second point to the precipitation of magnesium silicide.

(To be continued.)

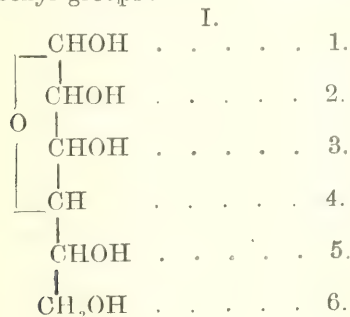
BRITISH ASSOCIATION.

SECTION B—CHEMISTRY.

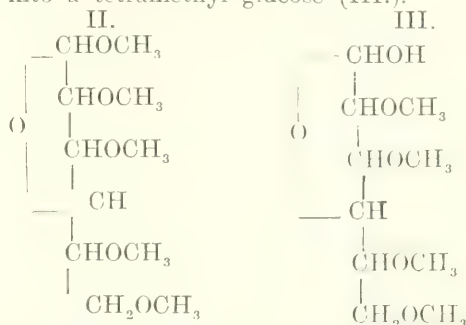
PART II.—SOME RESEARCH PROBLEMS IN THE CARBOHYDRATES.

CELLULOSE, STARCH, AND INULIN.

In submitting at this stage an account of the researches upon which my co-workers are at present engaged, I am impressed by the recollection that the first paper on the alkylation of sugars was read to Section B twenty years ago. The communication¹ dealt merely with the progressive methylation of methylglucoside and with the trimethyl and tetramethyl glucoses to which the products give rise. Even at that time it was recognised that the study of methylated sugars opened up a new method of attacking the constitutional problems of the carbohydrates, and the further progress reported to the Association in the following year showed how the process could be applied to determine, in part, the structure of sucrose and maltose². The principle underlying these studies may be very briefly stated. Adopting for the moment the accepted formula for glucose it will be seen that a hexose sugar contains five hydroxyl groups:—



It is to be noted that one of these groups differs from the remaining four in that, although it may be replaced by a methyl group, this is easily removed by acid hydrolysis. On the other hand, when methyl groups are introduced into the remaining positions (numbered 2, 3, 5, and 6 in the formula), they are exceedingly resistant to hydrolytic action. It follows, therefore, that a fully methylated glucoside (II.) when heated with acid will be converted into a tetramethyl glucose (III.).



Similar reactions are impossible with acetyl or benzoyl derivatives of sugars owing to the ease with which the substituting groups are eliminated. In order to illustrate the utility of methylation in determining structure, we may ascribe to any sugar derivative the general formula S—G, where S is a sugar residue and G the group with which it is condensed. Complete methylation may be effected, according to the solubilities involved, by silver oxide and methyl iodide or, alternatively, by methyl sulphate and alkali. The compound obtained will yield, on hydrolysis, at least two products, one of which is a methylated sugar. Determination of the number and distribution of the methyl groups in each of the cleavage products gives the structure of the parent compound, as the mode of attachment of the constituents is thereby known.

In the special case where the group G is also a sugar residue the general formula of the complex may be written S—S₁. The compound would thus be a disaccharide, and precisely the same structural study can be applied to it. The method is equally applicable to trisaccharides, S—S₁—S₂, and finally to polysaccharides S S_n.

The development of this line of research has demanded the preparation of a large variety of methylated sugars, which play the part of reference compounds in that

the position of the alkyl groups in them is known.

As I wish to deal particularly with the constitutional problems of polysaccharides, I shall make no attempt to summarise the results which have been obtained in the study of the simple sugars, the glucosides, or the disaccharides, but turn at once to the case presented by cellulose.

CELLULOSE.

(With Dr. W. S. Denham and Dr. E. L. Hirst.)

The extensive literature which has grown up on the constitution of cellulose affords little satisfaction to the organic chemist. Despite the complications involved and the many liabilities to error, it seems impossible for workers on cellulose to resist the temptation to ascribe a molecular formula to the compound. The difficulties which stand in the way are too numerous to mention, but the marked stability of cellulose under some conditions and its curious reactivity under others, coupled with its limited solubility and lack of volatility, are outstanding obstacles. As a result, many divergent and even conflicting suggestions have been put forward to represent the polysaccharide structurally, and the views of chemists both within and without the large circle of workers in this field are chaotic. The confusion is increased by the fact that many formulæ for the compound are published in haste to be corrected at leisure, and this unhappy state of affairs was never more pronounced than to-day. I would refer you to an article by Hans Pringsheim* in which he classifies the mentality of investigators and puts forward a plea that, if sure progress is to be made, the chemistry of polysaccharides must be pursued slowly step by step. Impetuous and hasty theorising does infinite harm.

The first essential in arriving at a satisfactory formula for cellulose is to ascertain if the aggregate $(C_6H_{10}O_5)_n$ is composed entirely of glucose units, as even this fundamental point has been disputed. To obtain the necessary evidence is not so simple as might appear, and many of the "proofs" which have been offered do not carry conviction to those familiar with the

detailed chemistry of the simple sugars. By converting cellulose into the triacetate and thereafter decomposing this product so as to give methylglucoside, we have recently obtained data which leave no doubt that glucose alone is the basis of cellulose.⁴ The yield of pure crystalline methylglucoside thus isolated amounts to more than 95 per cent. of the theoretical yield calculated on the basis of the equation:—



This result applies only to cotton cellulose, and further discussion is therefore restricted to this particular variety. Disregarding structures which are not based upon glucose, the numerous formulæ proposed for cellulose may be approximately divided into two classes:—

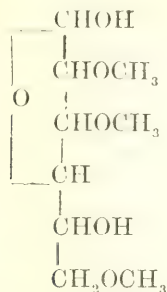
1. Constitutions modelled on that of the glucosides, involving the addition of numerous glucose residues by mutual condensation. According to this view, cellulose consists of large molecules.

2. The unit of cellulose may be regarded as a simple anhydroglucose, $C_6H_{10}O_5$, highly polymerised.

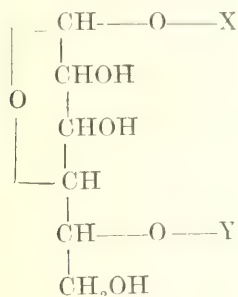
As pointed out, the situation alters almost from day to day, but for the moment a compromise between the above classes is supported, and some authorities prefer to regard cellulose as a simple anhydro-*n*-saccharide (where *n* is a small multiple) polymerised in unknown numbers.

Twelve years ago, after developing the methylation process into a trustworthy method for determining the linkages of sugar complexes, we turned our attention to the constitution of cellulose. The work was undertaken by Dr. W. S. Denham,⁵ who, using methyl sulphate and sodium hydroxide as the alkylating reagents, obtained a methylated cellulose in which the methoxyl content was 25 per cent. This value is lower than that required for a dimethyl cellulose (32.6 per cent.), and it followed that, on hydrolysing the product, a mixture of methylated glucoses resulted. From the mixture one definite sugar was isolated, and this Denham⁶ proved to be 2, 3, 6-trimethyl glucose (IV.), which was then isolated for the first time.

IV.



Denham's work thus gave the first clear evidence as to the linkage of part of the cellulose molecule, and is one of the most important contributions made to the structural study of complex carbohydrates. Cellulose must contain the unit



but as an incompletely methylated cellulose was employed in the hydrolysis the research left unexplained the nature of the residues X and Y.

The investigation was therefore continued with the object of completing the methylation of cellulose and providing answers to the following questions:—

(a) does trimethyl cellulose give, on hydrolysis, a mixture of methylated glucoses in which the average methoxyl content is three groups per C_6 unit,

or alternatively,

(b) if trimethyl cellulose gives trimethyl glucose alone, is this sugar a single individual or a mixture of isomerides?

The war interfered with the progress of the work, but other authors have not hesitated to propose formulæ for cellulose based on Denham's results before he had an opportunity to complete his researches and provide answers to the fundamental questions raised above.

In consultation with Dr. Denham we have repeated his experiments, and amplified them, so that we are now in a position to propose a structure for the cellulose unit which is based on secure evidence. We find that the exhaustive methylation of the polysaccharide, when repeated twenty times, gives a product containing 43.0 per cent. of methoxyl in place of the 45.6 per cent. required for a trimethyl derivative. The carbon and hydrogen values also agree with the formula $(\text{C}_6\text{H}_7\text{O}_2(\text{OMe})_3)_x$, and as the material preserved a fibrous structure there seems little likelihood that profound molecular alteration had taken place. The trimethyl cellulose was heated with a large excess of methyl alcohol containing 1 per cent. of hydrogen chloride for fifty hours at $125\text{--}130^\circ$. This treatment effected depolymerisation, hydrolysis, and conversion of the scission products into the corresponding methylglucosides. These were distilled in a high vacuum, the total yield obtained being 90 per cent. of the theoretical amount. The following fractions were collected:—

A. Trimethyl methylglucoside.

B. Trimethyl methylglucoside.

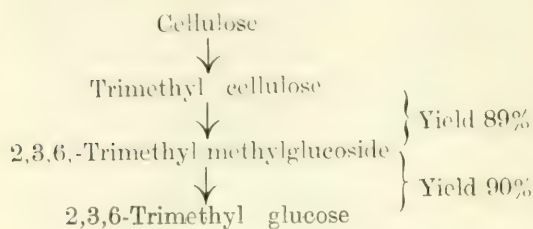
C. Trimethyl methylglucoside containing a small proportion of dimethyl methylglucoside.

All the fractions were analysed, and in this way it was shown that the small quantity of dimethyl methylglucoside in fraction C agreed exactly with the deficiency of 2.6 per cent. in the methoxyl content of the trimethyl cellulose used. *No trace of tetramethyl methylglucoside was present.* Moreover, the physical constants of the trimethyl methylglucoside agreed exactly with those recently established for this compound by Irvine and Hirst⁷. On hydrolysis of fractions A and B, an 89 per cent. yield of crystalline 2,3,6-trimethyl glucose was obtained. The identity of this product was confirmed by analysis, by mixed melting-point with an authentic specimen, and by the mutarotation in aqueous solution

$$[\alpha]_D + 108^\circ \rightarrow +67.0^\circ$$

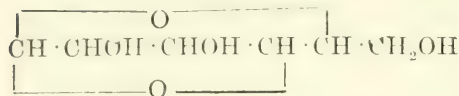
No isomeric trimethyl glucose was present; higher and lower methylated glucoses were absent. We thus reach the conclusion that trimethyl cellulose gives 2,3,6-trimethyl glucose as the only product. The reactions involved in the research are shown below, and, considering the nature

of the operations involved, the yields may be claimed to be quantitative.



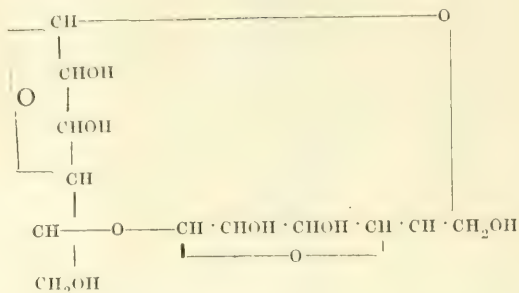
The scheme affords a proof that all the glucose residues in α -cellulose are identical in structure, and the simplest possible formula which will satisfy this condition is that of a 1,5-anhydro-glucose.

VI.



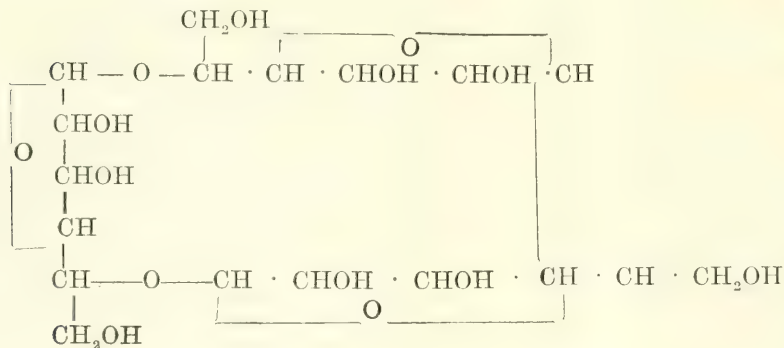
It is necessary, however, to include at least one additional glucose unit to account for the formation of cellobiose,* and this is fulfilled by the formula

VII.



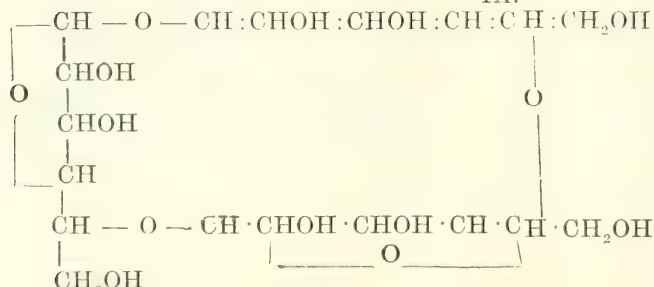
In terms of the above structure, 100 parts of cellulose should give 105.5 parts of cellobiose, and here the difficulty is encountered that the yields of this disaccharide are extremely variable, and rarely exceed 35 per cent. The highest claimed is of the order 50-60 per cent., and in the meantime it is prudent to select a formula for cellulose which will give a result only slightly higher than this figure. We therefore propose the symmetrical tri-1,5-anhydro-glucose (VIII.) for the unit of cellulose, on the ground that this structure would give a 79 per cent. yield of cellobiose as the theoretical maximum.

VIII.



There is, however, an alternative method of coupling the glucose residues, and this gives the structure shown in Formula IX.

IX.

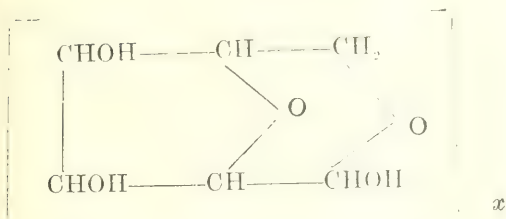


Taking into account the fact that it can yield only one disaccharide, we prefer Formula VIII. to the above structure. The essential properties of cellulose, so far as they are displayed in chemical reactions, are accounted for by both formulæ. Further, the structures are not inconsistent with the production of bromomethyl furfuraldehyde⁹ from cellulose, and indicate that the normal yield of this derivative involves the reaction of one-third of the total unit.

The various formulæ which, in the past, have been proposed for cellulose have been summarised by Hibbert.¹⁰ With the exception of a structure suggested by this author, and in supporting which he prematurely assumed that only one form of trimethyl glucose could be obtained from cellulose, the structures he tabulates do not in any case agree with the evidence we now produce. Typical examples are quoted:—

Green's formula :—

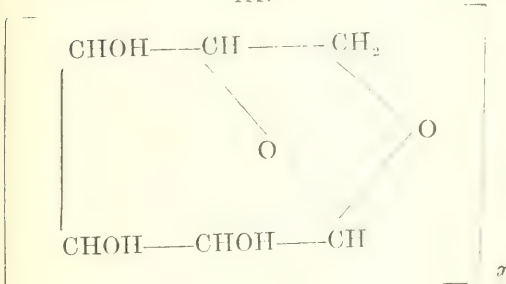
X.



would give a trimethyl cellulose which on hydrolysis would lose one methyl group and be converted into 3,4-dimethyl glucose of the amylenoxide type.

Vignon's formula¹² :—

XI.

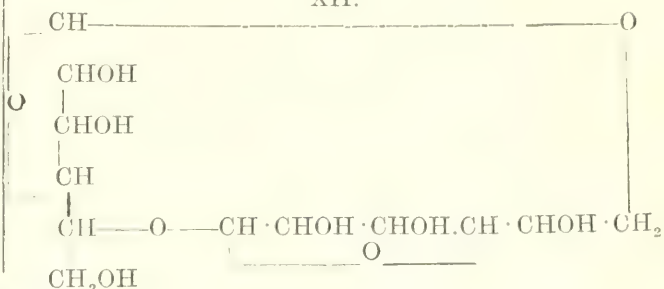


is equally unsatisfactory in that the final product should then be 2,3,4-trimethyl glucose of the amylenoxide type.

The formulæ proposed by Tollens,¹³ Cross

and Bevan,¹ Bartelemy,¹⁵ and Pictet¹⁶ may be deleted for similar reasons. It is also possible to dispose of Karrer's¹⁷ formula, which is that of an anhydro-cellobiose (termed "cellosan")

XII.

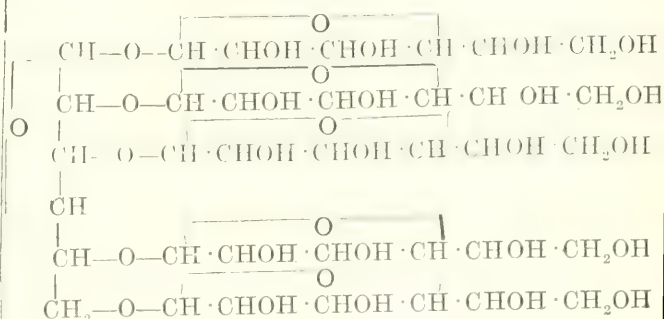


A compound possessing this structure would yield, on methylation and hydrolysis,

1 molecule of 2,3,5-trimethyl glucose and 1 molecule of 2,3,6-trimethyl glucose. Our experimental evidence is completely opposed to this view.

An entirely different type of cellulose formula may now be tested. Hess proposes¹⁸ a glucosidic structure which bears a general resemblance to Fischer's constitution for tannins. Space does not permit of these formulæ being given in full, but the general form will be evident from the simplest example:—

XIII.



Variations are introduced by lengthening the sugar chains until finally a molecule is obtained with eighteen glucose residues ($C_{108}H_{162}O_{91}$). The feature common to all these glucosidic formulæ is that the hydroxyl groups are not symmetrically distributed in the glucose residues. The simplest structure suggested by Hess would give by our processes five molecules of 2,3,5,6-tetramethyl glucose and one molecule of glucose, while his more elaborate molecules would also result in these com-

pounds together with trimethyl glucose. The reactions of trimethyl cellulose exclude all formulæ of this nature.

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GERMANY'S COAL POSITION.

German industry generally is suffering more and more from the loss of the valuable coal measures alienated to other countries, and intensified by the deliveries required for the Allies. Interesting efforts, as is known, are being made in the country to get greater relative value out of the coal available.

The Capetown correspondent of the *Manchester Guardian Commercial* gives an account of the recently reported new discovery of gold in the West Rand. "If it be true that a new reef has been discovered," he says, "and that it will pay to work, there will be no lack of capital to promote new propositions. It is a little early to speak definitely in regard to this prospect. Men are being attracted to the new fields, and prospecting is in progress. Those who are supposed to know are sanguine, and the hope is held out that the mining industry will shortly assume increased attention. Apart from this, however, South Africa is moving forward as a producing country. The fruit trade is increasing by leaps and bounds, and its future is assured. The export trade is, in point of fact, overtaking the capacity of the shipping companies and the port facilities. Greater cold-storage accommodation on board the fast steamers is demanded, and the Government is being pressed to increase the storage accommodation of the Capetown docks. Indeed, it is just a question whether in the near future it will not be necessary to place on the service vessels specially constructed to deal with the fruit trade. The output of citrus fruit is increasing yearly. The crops in Rhodesia, Transvaal, Orange Free State, and, of course, the Cape, are improving in quantity and quality, and apparently the demand for high-grade oranges overseas is unlimited. Other promising indications are the increasing exports of bacon, dairy produce, and meat. In short, the hope is held out that as the mining areas depreciate the country will be able to derive ample compensation from developments in its farming enterprises."

CEVADINE.

By A. K. MACBETH AND R. ROBINSON.

Cevadine, $C_{32}H_{49}O_9N$ is one of the alkaloïds present in the seeds of *Veratrum Sabadilla*, which on hydrolysis gives cevine

$C_{27}H_{48}O_8N$ and tiglic acid (Wright and Luff, *Trans.*, 1878, p. 338.) The present authors confirm this empirical formula on a sample of cevadine recrystallised from alcohol and dried *in vacuo*. It is dextro-rotatory, $[\alpha]_D^{170}$ in alcohol being $+12.5^\circ$, in pyridine $+6.38^\circ$, and in acetone $+1.25^\circ$. O-nitrobenzoylcevadine was prepared by adding o-nitrobenzoyl chloride to an alkaline solution of cevadine; on recrystallisation pale yellow crystals M.P. 220° – 236° C. (decomp.) were obtained. On hydrolysis with alcoholic potash, potassium cevine separated out in crystals from which cevine was obtained by decomposing with CO_2 . Recrystallisation from aqueous alcohol gave $C_{27}H_{48}O_8N \cdot 5H_2O$. The compound was levorotatory $[\alpha]_D^{170}$ in alcohol being -17.52° , in methyl alcohol -15.36° , and in acetone -30.8° . On methylation, an amorphous methoxy compound $C_{27}H_{42}O_8N$ (O Me) was formed.

Di-(o-nitrobenzoyl) cevine was prepared by the Schotten Baumann method. It is a pale yellow powder, M.P. 175° and levorotatory, $[\alpha]_D^{170} = -54.7$ in alcohol. On distillation with soda lime in a stream of hydrogen a substance responding to the reactions for l-coniine was isolated. (*J.C.S., Trans.*, 1922, p. 1571.)

BRITISH ASSOCIATION.

FUEL ECONOMY.

Fifth Report of Committee (Professor W.

A. BONE,* *Chairman*; Mr. H. JAMES YATES,* *Vice-Chairman*; Mr. ROBERT MOND,* *Secretary*; Mr. ROBERT ARMITAGE, M.P., Mr. A. H. BARKER, Professor P. P. BEDSON, Dr. W. S. BOULTON, Professor W. E. DALBY, Mr. E. V. EVANS,* Dr. W. GALLOWAY,* Mr. J. E. HACKFORD, Sir ROBERT HADFIELD, BART.,* Dr. H. S. HELE-SHAW,* Mr. D. H. HELPS, Dr. G. HICKLING, Mr. A. HUTCHINSON,* Mr. S. R. ILLINGWORTH, Principal G. KNOX, Professor HENRY LOUIS,* Mr. H. M. MORGANS, Mr. E. MYERS, Dr. J. S. OWENS, Mr. W. H. PATCHELL,* Mr. H. STAFFORD RAYNER, Mr. L. L. ROBINSON, Mr. A. T. SMITH, Dr. J. E. STEAD, Mr. C. E. STROMEYER, Mr. W. C. P. TAPPER, Mr. W. THORNEYCROFT, Professor W. W. WATTS,* and Mr. C. H. WORDINGHAM*)

appointed for the Investigation of Fuel Economy, the Utilisation of Coal, and Smoke Prevention.

* Denotes a member of the Executive Committee.

I.—THE COAL SITUATION.

Since the Committee last reported, the fuel situation in this country has been dominated by the effects of the coal crisis of 1921. The output of coal from mines in Great Britain during the year ending December 31, 1921, fell to 163 million tons, of which 24.66 million tons were exported, and a further 11 million tons (including about 133,000 tons of manufactured fuel) were consumed by steamers engaged in the foreign trade. There were also exported 443,565 tons of gas coke, 850,074 tons of manufactured fuel, and 292,648 tons of other sorts of coal fuel. Owing to the coal stoppage, there were imported into the country during the year (but chiefly during the three months, April–July inclusive) altogether some 3,433 million tons of coal, and 136,424 tons of coke and manufactured fuel.

In its last Report, the Committee drew attention to the effects of the then high coal prices upon the prospects of the iron and steel industry in this country; and as this particular industry reflects almost better than any other the effects of coal prices upon production, the following observations may appropriately be made upon the present situation.

The crisis of last year in the coal trade was the final cause of the severe depression which in the pig-iron and steel trade had gradually been setting in since the miners' strike in the autumn of 1920. The latter came upon the trade following a period of high prices and abnormally high demand, and precipitated a complete cessation of business and great difficulty in obtaining new orders. This was further accentuated by the general post-war economic conditions in the world's markets. At the same time on the Continent there was a cheapening in the cost of production, together with a serious drop in exchange values and pressure of the banks on the Belgian and French works to realise stocks, and in consequence the foreigner was enabled to deliver pig-iron into Great Britain at a lower price than it could be made at home. Hence, whilst the pig-iron sales had been

maintained fairly well up to the end of 1920, the first months of 1921 saw the importation of both pig-iron and steel into Great Britain on a large scale, foreign pig-iron being delivered into Scotland about thirty shillings per ton below the cost of manufacture in Great Britain. The coal crisis of the following months completed the disaster.

The combined effect of these various causes is well shown by contrasting the production of pig-iron and steel in the United Kingdom in the years 1920 and 1921 respectively. During the year 1920 the output of pig iron was 8,034,700 tons, and of steel 9,067,300 tons; in 1921 these figures had fallen to 2,611,400 and 3,625,800 tons respectively. The following analysis of the corresponding productions for each quarter of 1921 is very instructive in this connection:—

	Pig-iron Tons.	Steel Tons.
January-March	1,491,700	1,336,000
April-June	74,700	79,000
July-September	262,700	980,600
October-December ..	782,300	1,230,200
	2,611,400	3,625,800

On operations being resumed at the mines, production at iron and steel works restarted on a very restricted scale, and with the low prices then prevailing was carried on at a heavy loss. Despite subsequent reductions in wages due to the operation of sliding scales and other mutual arrangements, and in the excessively high railway rates, which gave manufacturers less relief than had been hoped for, there still seems little hope of further reductions in the present prices of pig iron and steel, the cost of fuel delivered to the works being still too high.

From a fuel-economy point of view the position is most unsatisfactory, because at

present the prices of coke as compared with those of coking coals delivered at the works offer little inducement to iron and steel makers owning self-contained plants to start up the coke ovens connected with their steelworks, since coke can be bought at prices below the cost of making it in their own ovens, even after crediting the values of all the by-products produced in the process. This condition is entirely abnormal; and it is hoped that with improved general trade, freedom from industrial disputes and unrest, and an increase in demand, more blast-furnaces and steelworks will be put into operation, and that the demand for the raw materials will then tend to re-establish more normal conditions in the coal and coke trade, and thus restore the balance in favour of pursuing a policy which ensures the greatest fuel economy in the operation of plants, which is so desirable in the national interests.

II.—OIL FUEL SUPPLIES—PRESENT AND FUTURE.

The Present Situation.—During the past year the Committee has had under consideration the important question of present and future supplies of oil fuel which are now needed for certain purposes (chiefly motor transport) for which at present coal cannot well be used. In this connection they have had the valued help of Mr. J. E. Hackford, who was co-opted on to the Committee on the nomination of the Institution of Petroleum Technologists.

As a first step towards the exploration of the subject, the Committee decided to collect authentic information as to the importation of petroleum products into the United Kingdom during each of the five years 1917-1921 inclusive. For purposes of reference the data so collected have been analysed and tabulated as follows:—

TABLE I.

Imports of Petroleum Products into the United Kingdom for the years 1917 to 1921 inclusive.

	(Tons.)	1917.	1918.	1919.	1920.	1921.
Crude Oil		1.65	—	31,388.0	17,417.1	426,151.0
Lamp Oil		456,995.4	528,644.6	544,185.0	574,828.2	536,575.6
Motor Spirit		422,030.9	584,724.3	602,324.8	629,511.5	768,287.5
Lubricating Oil		351,188.0	409,095.2	263,332.0	426,656.0	204,059.8
Gas Oil		120,400.0	149,375.0	115,511.1	206,018.4	304,736.6
Fuel Oil		1,835,759.1	3,515,020.8	1,105,855.0	1,425,045.6	2,255,822.2

TABLE II.

Imports of Petroleum Products for the year ending December 31, 1921.

[Customs corrected returns in tons, to the nearest decimal place.]

Origin.	Motor Spirit.	Kerosene.	Lubricating Oil.	Fuel Oil.	Gas Oil.	Crude Oil.	Others.	Total.
U.S.A.	414,165.7	440,410.6	192,185.3	820,610.4	292,181.3	7,533.9	300.5	2,167,387.7
Mexico	68,430.9	59,182.7	13,911.4	1,129,738.3	996.5	61,982.6	—	1,333,362.4
Dutch E. Indies	109,211.1	—	0.5	8,943.7	—	—	—	118,155.3
Dutch W. India Islands	5,649.5	—	—	—	—	—	—	5,649.5
Poland	—	—	19.8	—	2,184.0	—	—	2,203.8
Peru	9,092.9	—	—	—	—	—	—	9,092.9
Roumania	9,426.7	20,900.5	—	—	—	6.0	—	30,333.2
Russia	—	4,771.3	1,372.0	—	—	—	—	6,143.3
Persia	117,654.7	—	—	178,263.9	—	350,650.4	—	646,569.0
Other Foreign Countries	0.2	70.3	1,465.5	31,731.1	374.8	13.2	16.6	33,671.7
Total from Foreign Countries	733,631.5	525,335.4	208,054.5	2,169,307.4	295,736.6	420,186.1	317.1	4,352,568.6
British India	8,458.5	—	5.1	—	—	—	—	8,463.6
British W. India Islands	6,870.7	5,635.6	—	85,483.8	—	5,964.8	34.8	103,989.7
Canada	—	—	—	—	—	—	8.8	8.8
Egypt	6,314.4	5,605.1	—	1,042.0	—	—	—	12,961.5
Sarawak	10,571.8	—	—	—	—	—	—	10,571.8
Straits Settlements	2,439.5	—	—	—	—	—	—	2,439.5
Other British Possessions	—	—	0.2	—	—	—	4.4	4.6
Total from British Possessions	34,654.9	11,210.7	5.3	86,525.8	—	5,964.8	48.0	138,439.5
Total	768,286.4	536,576.1	208,059.8	2,255,833.2	295,736.6	426,150.9	365.1	4,491,008.1
Percentage from Countries outside the Empire	95.5%	97.9%	100.0%	96.1%	100%	98.6%	86.9%	96.9%

The Committee then proceeded to inquire into the origins of our present imported oil-fuel supplies, and for that purpose the statistics for the year ending 1921 were analysed (see Table II.) so as to discriminate between the various countries of origin, and also to show how much of our total imported supplies of petroleum and petroleum products are being drawn from within the Empire itself.

The Committee considers it important that attention should be drawn to the fact that, inasmuch as the home production of shale oil is now very small,¹ owing to the relatively low cost of production of imported petroleum, we are at present dependent almost entirely on countries outside the Empire for the supplies of natural petroleum and petroleum products, a most undesirable and dangerous state of affairs from every point of view.

The Gas and Coking Industries as Producers of Motor Spirit.—It would appear that the only practicable way in which home supplies of motor spirit and fuel oils can be extended is by the carbonisation of bituminous coals at temperatures between 600° C. and 1,200° C. By carbonising suitable British coals at high temperatures (1,000° C. to 1,200° C.) in gas retorts or by-product coke ovens there can be obtained between 3 and 6 per cent. of the weight of the dry coal as anhydrous tar, and between 0.75 and 1 per cent. of its weight as refined benzole (motor spirit). It should be borne in mind, however, that, inasmuch as more than half of the coal so carbonised is for the production of hard metallurgical coke, the total production of motor spirit and tars by these methods depends very largely upon conditions in the iron and steel industries which fluctuate and at the present time are exceedingly bad. Supposing, however, that pre-war prosperity were restored to the iron and steel industries, a total high temperature carbonisation of some 40 million tons of coal per annum might reasonably be expected. Taking 1 per cent. of its weight as a probable outside limit for the ultimate production of refined benzole, the total potential production of the latter would

not exceed 400,000 tons per annum, which is very little more than half the tonnage of the motor spirit actually imported into the country in the year 1921. Moreover, of this potential supply, nearly half would have to be drawn from the gasworks of the country, and it is at least problematical whether it would pay the gas companies to extract the benzole from their gas at present prices. Indeed, taking the present relative prices of gas and benzole, as well as the costs of recovering benzole from coal gas, it is probable that the cash value of the potential heating power of benzole is greater when left in the gas than it is when extracted therefrom and (after subsequent refining) sold as motor spirit.

(To be continued.)

GENERAL NOTES.

THE NORWEGIAN INDUSTRIES FAIR, CHRISTIANA, SEPTEMBER, 1922.

The Fair was held for the third time in Christiania, the attendance was as good as the preceding years. The products included feeding stuffs, confectionery, textile products, machinery, tools, and electrical apparatus. The chief chemical industries of Norway, nitre, cellulose, and wood pulp, owing to trade depression, were not very prominent. There was a good display of pharmaceutical preparations, soaps, oils, varnishes, etc. Aluminium vessels made from Norwegian aluminium made a good show. The Norwegian exchange is the lowest of the Scandinavian countries, a fact that attracted many buyers, both from Norway and abroad.

The Secretary of the Fair is M. H. Sebelien.

EGYPT.

TENDERS INVITED.

The British Commercial Agent for Egypt has notified the Department of Overseas Trade that the Frontier Districts of Administration, Alexandria, is inviting tenders for the supply of consumable stores, oils and paints. Tenders, on the proper form accompanied by a provisional deposit of 2

¹ Thus in the year 1920 the amount of oil-shale mined in Great Britain was 2,840,859 tons, from which it may be estimated that no more than about 227,000 tons of oil would be produced.

per cent. of the total value of the tender, should reach the Director of Stores, Frontier Districts Administration, Alexandria, by noon on the 10th October next.

The schedule is rather extensive, and includes, among other goods, oils, paints and varnishes, hardware, brushware, canvas, lamp glasses, leather, rope (manilla and wire), soap, etc.

The schedule, conditions of tender, and specifications can be seen by United Kingdom firms interested, on application to the Department of Overseas Trade (Room 84), 35, Old Queen Street, London, S.W.1.

Local representation is essential. The Department will be pleased to supply United Kingdom firms not already represented with the names of firms who may be willing to act for them in this matter. (Ref.: 9008/F.E/G.P.)

CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETINGS AND LECTURES—SESSION 1922-1923.

1922.

Thursday, October 5th, at 8 p.m.; Thursday, October 19th, at 8 p.m. Thursday, October 26th, at 8 p.m., lecture by Sir W. H. Bragg, K.B.E., F.R.S., and Prof. W. L. Bragg, O.B.E., F.R.S.

Thursday, November 2nd, at 8 p.m.; Thursday, November 16th, at 8 p.m., and Informal Meeting.

Thursday, December 7th, at 8 p.m.; Thursday, December 14th,† at 8 p.m., lecture by Prof. C. H. Desch, D.Sc., Ph.D.; Thursday, December 21st, at 8 p.m.

1923.

Thursday, January 18th, at 8 p.m.

Thursday, February 1st, at 8 p.m.;

Thursday, February 15th, at 8 p.m.;

Thursday, February 22nd,† at 8 p.m., lecture by Princ. J. C. Irvine, C.B.E., F.R.S.

Thursday, March 1st, at 8 p.m.; Thursday March 15th, at 8 p.m.

Thursday, April 19th, at 8 p.m.

Thursday, May 3rd, at 8 p.m.; Thursday, May 10th,† at 8 p.m., Baeyer Memorial Lecture by Prof. W. H. Perkin, LL.D.,

F.R.S.; Thursday, May 17th, at 8 p.m., and Informal Meeting.

Thursday, June 7th, at 8 p.m.; Thursday, June 21st, at 8 p.m.

Annual General Meeting, Thursday, March 22nd, 1923, at 4 p.m. The Anniversary Dinner will be held the same evening.

† To be held in the Meeting Hall of the Institution of Mechanical Engineers, Storey's Gate, S.W.1.

LECTURES.

The following lectures will be delivered during the coming session, and, by the courtesy of the Council of the Institution of Mechanical Engineers, will be held in the Lecture Hall of that Institution (Storey's Gate, Westminster, S.W.1):—

October 26th, 1922, at 8 p.m.: *The Significance of Crystal Structure*, by SIR WILLIAM H. BRAGG, K.B.E., F.R.S., and PROFESSOR W. L. BRAGG, O.B.E., F.R.S.

December 14th, 1922, at 8 p.m.: *The Metallurgical Applications of Physical Chemistry*, by PROFESSOR CECIL H. DESCH, D.Sc., Ph.D.

February 22nd, 1923, at 8 p.m.: *Some Constitutional Problems of Carbo-hydrate Chemistry*, by PRINCIPAL J. C. IRVINE, C.B.E., F.R.S.

May 10th, 1923, at 8 p.m.: *Baeyer Memorial Lecture*, by PROFESSOR W. H. PERKIN, LL.D., F.R.S.

INFORMAL MEETINGS.

The rooms of the Society will be open for Informal Meetings on November 16th, 1922, and on May 17th, 1923. Light refreshments will be provided and smoking permitted.

THE HOUSEHOLDER'S COAL.

The question of domestic coal prices continues to arouse interest in consequence of the prospect of further slight increases.

Inquiries in the district supplying the metropolis and other large centres with household fuel show that there has been nothing in the nature of a general increase by the collieries, and that no such increase is anticipated. It appears that one or two collieries have slightly increased their prices within recent weeks. These con-

cerns were, however, selling at exceptionally low prices, having made a greater reduction than the average when the pit-head figure slumped, and they have merely made such slight advances as to bring them in line with the other collieries of the district.

It is often asked who obtains the benefit from "high prices" now that the miners' wages are down to the minimum. It may be said at once that the collieries have not benefited by increased profit. This is borne out by recent official figures showing that the average loss on all coal drawn in the Eastern Federated Area—the districts which supply London and the South—was nearly 1s. 6d. per ton in the month of June.

As the following figures show, the actual pit-head price of those qualities of coal most largely used by the bulk of householders is very considerably less than one-half of the total.

	s. d.
Pit price	19 0
Railway rate	9 6
Wagon hire	2 0
Distribution charges	12 6

(Includg. retailer's profits) 43 0

The latter item includes loaders' and carmen's wages, cartage expenses, sacks, siding rents, salaries and establishment charges, and profits.

Derby Brights are sold at an additional shilling per ton, the pit-head price being a shilling more than that of the fuel previously mentioned. In 1913 the pit-head price of this fuel was 13s., railway rate and wagon hire amounted to 7s. 4d., and distribution charges 6s. 8d., the total making 27s. The present price is thus about 63 per cent. above pre-war.

PRODUCTION OF CATALYSTS.

L. DUPARC AND C. URFER.

Lithium, uranium, titanium, calcium, barium, strontium, and a few other metals are found to yield pulverulent nitrides when heated with nitrogen. These nitrides easily decompose when heated in a current of hydrogen, and this property is made use of in the production of synthetic ammonia.

To produce the metal in a suitable state, its oxide is caused to react with a reducing metal, such as aluminium. The resulting pulverulent mass consists mainly of the reduced metal in a very finely divided and

pure state distributed over the surface of the alumina. The catalyst thus prepared is very valuable for the production of synthetic ammonia at comparatively low temperatures and at atmospheric pressure.—*Brit. Pat.* 140,061, 1921. (*Journal of the Society of Dyers and Colourists.*)



This list is specially compiled for *Chemical News* by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs can be obtained gratuitously.

Latest Patent Applications.

- 22781—Boake, Roberts, & Co., Ltd.—Distilling and fractionating apparatus. Aug. 22.
- 23672—Casale, L.—Apparatus for catalytic synthesis of ammonia. Aug. 24.
- 23083—Fairlie, A. M.—Acid plant equipment. Aug. 25.
- 22888—Grädl, J.—Manufacture of artificial manures. Aug. 22.
- 184206—Williams, J. G.—Process of manufacturing soluble phosphates.
- 184211—Withers, J. S.—Method and means for utilising the heat contained in the fuel residues of furnaces.
- 167143—Little Inc A.D.—Process of preparing cellulose butyrate.
- 184244—Chemische Fabrik Greisheim Elektron.—Process for the electrolytic production of potassium bi-carbonate from potassium chloride solutions.
- 184279—Dale, A. G.—Apparatus for the analysis and recording of gases.
- 184284—Galbraith, W. L.—Manufacture of amines from phenolic compounds.

Abstract Published This Week.

Urea.—Patent No. 182331.—Mr. J. Y. Johnson, of 47, Lincoln Inn Fields, London, has patented in this country a process for the manufacture of urea.

It is carried out by forcing a mixture of ammonia and carbon dioxide into an autoclave, the gases are brought to the necessary pressure by expelling either or both of them from solutions capable of giving them off, by means of heat. By way of example, a concentrated solution of ammonium carbonate or carbamate is forced into a heated column, the gas mixture produced passed through a cooler at about 110-150° C., and the condensate run into an autoclave where it is heated at 130-150° C., until the conversion into urea no longer proceeds. The autoclave may be filled and discharged either at intervals or continuously, or the process can be carried out with single charges, when the column is replaced by a pressure resisting vessel. The unconverted gases are expelled from the urea solution and used together with fresh gases, to saturate the exhausted liquid from the column for further use. The gaseous ammonia and carbon dioxide may be generated in separate columns, for example, from aqueous ammonia and sodium or ammonium bicarbonate solution respectively, or one of the gases may be forced into the autoclave by means of a compressor.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3259

THE INSTITUTE OF METALS.

ANNUAL MEETING, SWANSEA,
SEPTEMBER 20TH, 1922.*(Continued from Page 165.)*

Summary of Paper on "THE COPPER-RICH ALUMINIUM-COPPER ALLOYS," by D. STOCKDALE, B.A., presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, Thursday, September 21st, 1922.

The structures of the alloys of copper with aluminium up to 20 per cent. of aluminium have been investigated by Stockdale, who used the thermal data supplied by a study of the cooling-curves of the alloys and by quenching experiments in conjunction with microscopic examination in order to obtain the equilibrium diagram more exactly. He discredits the opinion that the addition of small quantities of aluminium to pure copper raises the freezing point of that metal, and shows that the minimum in the liquidus curve at 1,031° C. with 8.3 per cent. of aluminium is a true eutectic point. A small arrest point at 1,017° with alloys containing between 16.5 and 18 per cent. of aluminium has been discovered, but there is no indication of a minimum in the liquidus at about 16 per cent.

Copper, at 1,000° C. can hold only 7.4 per cent. of aluminium in solid solution; at 500° C. and at lower temperatures it can hold 9.8 per cent., although to obtain such an alloy a long annealing is required. The β solid solution breaks down above 350° C., and Andrew's observations on the α and δ constituents have been confirmed. That portion of the diagram concerning the β and δ field has been radically altered.

The paper was fully illustrated by microphotographs.

Summary of Note on "THE CLEANING OF ALUMINIUM UTENSILS," by R. SELIGMAN, PH.NAT.D., and PERCY WILLIAMS, B.SC., presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, Thursday, 21st September, 1922.

For nearly half-a-century the difficulty of cleansing aluminium has hindered its

entry into household and factory. This difficulty has been due to the fact that the metal is freely dissolved by hot soda solution, the most common detergent. The difficulty disappears entirely if the simple device be adopted of adding very small quantities of sodium silicate to the soda. Some years ago the surprising observation was made that aluminium was immune to attack by water-glass solutions, which at once suggested that the well-known detergent properties of such solutions might be enlisted for cleaning the metal. This was done with complete success. Water-glass is, however, an inconvenient material to put into the hands of the general public, and the problem could not, therefore, be regarded as completely solved. Later it was found that even small quantities of sodium silicate in soda solutions produce the same effect as a solution of water-glass. For example, the attack by a 5 per cent. soda solution is immediately arrested by the addition of an amount of sodium silicate equal to 1/100 of the soda in the solution.

By this observation the problem may be considered solved, because detergents consisting of a mixture of soda and sodium silicate are articles of commerce and readily procurable in most parts of the world. Among those which have been used with complete success are compounds sold for domestic purposes under the following trade names: "Carbosil," "Pearl Dust," and "Aquamol." Boiling solutions made up with London tap water and containing 0.5 per cent. and over of these materials remove grease readily without affecting the aluminium in any way.

Summary of Paper on "THE EFFECTS OF OVERHEATING AND MELTING ON ALUMINIUM," by W. ROSENHAIN, D.Sc., F.R.S., and J. D. GROGAN, B.A., presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, Thursday, 21st September, 1922.

The work described in this paper was undertaken to ascertain whether certain forms of treatment in the melting and remelting of aluminium would bring about in the metal deterioration approximating to the condition generally described as "burnt" aluminium. It has been stated that exposure to an unduly high temperature during melting, and also repeated remelting of the same material, even at

ordinary melting temperatures, brings about such deterioration.

Both kinds of treatment were tried.

High grade aluminium was poured at temperatures up to $1,000^{\circ}\text{C.}$, and also at the usual pouring temperature after heating for some hours at $1,000^{\circ}\text{C.}$ The castings so obtained were rolled to sheet form and tested in the annealed state. No deterioration in the metal could be detected.

High grade aluminium, and also aluminium containing $\frac{1}{2}$ per cent. each of iron and silicon were cast to $\frac{3}{4}$ inch slabs and rolled to 0.01 inch sheet. This sheet was melted and cast, and the whole process repeated ten times. Test pieces cut from sheet 0.05 inch thick from each melt gave figures which indicated no systematic change in quality of the metal.

Summary of Paper on "THE STRUCTURE OF EUTECTICS," by F. L. BRADY, M.Sc., presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, Friday, 22nd September, 1922.

The paper deals with the structures exhibited by eutectics, mainly those between metals and metallic compounds. An attempt has been made to correlate the micro-structure of a solidified eutectic with the physical properties of the component metals. The surface tension of the molten metal, and the cohesive force acting during crystallisation seem to be the main forces influencing the final structure. The eutectics examined, which include those between metals whose physical forces are known, fall quite decidedly into three classes. The terms "globular," "lamellar," and "angular," have been suggested as convenient terms for these divisions. The structures agree well with what would be expected from theoretical considerations of the effects of surface tension and cohesion.

Reference is made to structures in eutectic igneous rocks, and an examination has been made of earlier work on the effect of rate of cooling on the size of the individual phase particles in a eutectic.

Photomicrographs are given of characteristic structures of the various alloys examined, and an account is given of the methods of polishing the alloys, and a list of the etching reagents found most suitable. It is hoped that the paper may lead to further investigation of the eutectic

structure as a means of comparing the properties of the component metals or compounds in other cases than those specifically dealt with.

Summary of Paper on "THE ANTIMONY-BISMUTH SYSTEM," by MAURICE COOK, M.Sc., presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, Friday, 22nd September, 1922.

Several workers have investigated the equilibrium diagram of these two metals, and though the opinion that the system is isomorphous is generally held, the diagram has never been completed. Early investigators gave only the liquidus curve, and Huttner and Tammann, in 1905, gave, in addition to a new liquidus curve, part of the solidus which they found to be horizontal at $266^{\circ} + 4^{\circ}\text{C.}$ and extending from 0 to 70 per cent. of antimony.

In the present work very thorough thermal and microscopic investigations have been made. The results obtained, in addition to those from quenching and annealing experiments, show that the two metals form an isomorphous series of alloys. The liquidus curve is perfectly smooth, and the solidus is horizontal at 270°C. up to 60 per cent. of antimony, after which it rises steeply to the freezing point of antimony. Chill cast and slowly cooled specimens reveal duplex structures, but with prolonged annealing—550 hours at 275°C. —the alloys become homogeneous.

Twin crystals and peculiar banded effects were observed in some of the annealed specimens. It is supposed that the twin crystals have been formed during the solidification of the alloy by stresses due to expansion, and have grown to visible dimensions on annealing. The nature of the "bands" has not been definitely ascertained, though they are not considered to be slipbands.

Summary of Note on "THE CAUSE OF RED STAINS ON SILVER-PLATED WORK," by A. JEFFERSON, presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, Friday, September 22nd, 1922.

The red stains sometimes observed on finished articles which have been electro-silver plated cause considerable annoyance, and their origin has been somewhat of a

mystery to those engaged in the trade.

The occurrence of the trouble in individual works is often intermittent, and by some has been considered seasonal and to be particularly prevalent in hot weather. The Sheffield Silver Trade Technical Society appointed a Committee to discuss the matter and subject it to experimental study. With a view to investigating the matter thoroughly and completely, it was decided to commence with the basis metal, and to make the test independent of the peculiarity of any one maker's metal, twelve nickel silver discs were obtained from stock ingots of three separate firms and given to four members of the Committee, three to each. All the discs were distinctly marked and subjected to the various processes necessary, no special care being taken to either cause or prevent any unusual result. After clearly marking the places where defects appeared on the prepared surfaces, the discs were all silver-plated at one time in one vat, and afterwards were subjected to the various processes of finishing and polishing, for which different compositions and rouges were used. The results of this final process were carefully compared, and it was found and definitely established that the red stain was caused by the indiscriminate use of rouge in the finishing and polishing processes, through the absorption of the rouge into the open pores of the heated surface, the heat being evolved by the friction of the hand or finishing "Dolly." A practical holloware finisher proved this by taking a perfectly finished disc and putting a distinct red band about three inches broad down the centre. It was stated that if a polisher or finisher would refrain from applying rouge to an over-heated surface and go to a fresh part of the surface, then return to the now cooled original part of the surface, red would not arise.

Summary of Paper on "INTERMETALLIC ACTIONS. THE SYSTEM THALLIUM-ARSENIC," by Q. A. MANSURI, B.A., M.Sc., presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, Friday, September 22nd, 1922.

Mr. Q. A. Mansuri, B.A., M.Sc., by means of thermal analysis and microscopic analysis, has shown that thallium and arsenic do not act chemically with each other, nor do they form solid solutions. They alloy in all proportions and the

equilibrium diagram of the system is a perfect case of the immiscibility type.

First, arsenic dissolves in molten thallium and lowers its freezing point until a solution of 8.01 per cent. arsenic freezes at the eutectic temperature of 215° C. Then the freezing points of the alloys gradually rise to 240° C. All alloys containing from 13 to about 40 per cent. arsenic begin to freeze at 240° C., and are made up of two layers the upper layer rich in arsenic while the lower rich in thallium. After about 40 per cent. arsenic, to nearly pure arsenic, the solution is uniform and the two layers disappear.

A method of taking the cooling curves of volatile substances has been explained. It has been shown that by heating such substances in evacuated and sealed glass tubes and applying the hot junction of the couple in close contact with the outside of the glass tube the couple is almost as sensitive as when dipped in molten substances.

Summary of Paper on "NEW FORMS OF APPARATUS FOR DETERMINING THE LINEAR SHRINKAGE AND FOR BOTTOM-POURING OF CAST METALS AND ALLOYS, ACCOMPANIED BY DATA ON THE SHRINKAGE AND HARDNESS OF CAST COPPER-ZINC ALLOYS," by F. JOHNSON, D.Sc., and W. GRANTLEY JONES, presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, Friday, 22nd September, 1922.

In this paper the authors describe two new forms of apparatus:—

(a) For determining the total linear shrinkage of cast metals and alloys;

(b) For producing cast bars by a bottom-pouring method, the molten metal flowing from a specially heated crucible into the mould and the rate of flow being controlled by a lever-operated stopper.

Both forms of apparatus have been used in investigating the shrinkage and hardness of chill-cast copper-zinc alloys.

As regards the shrinkage values of these alloys, they are found to be higher in general than those obtained for sand-cast bars by previous investigators. The curve illustrating the relationship of shrinkage to composition confirms most of the features formerly discovered by Turner and Murray, but no minimum at 60 per cent. copper is found.

In making the alloys pure electrolytic metals were used, whilst re-melted castings were excluded from the investigation. Most of the alloys were poured at a temperature interval of approximately 115°C . above their liquidi, and the mould was kept at a constant temperature by means of an outer jacket of water maintained at the boiling point.

The alloys were prepared in a separate coke-fired melting furnace, and transferred thence to the bottom-pouring apparatus, which is illustrated and described in detail. The advantages afforded by the use of this apparatus are many, viz.:—

- i. Control of pouring temperature;
- ii. Facility for registering temperature of metal;
- iii. Absence of delay between attainment of required pouring-temperature and release of metal into the mould;
- iv. Control of rate of pouring;
- v. Exclusion of dross from stream of metal, thus obviating the necessity for skimming;
- vi. Mitigation of "zinc-fume."

The hardness of the bars was determined, both as cast and after annealing. Uniformity was not exhibited by the bars as cast, but was secured by annealing. In the case of the annealed bars, the hardness numbers both by the Brinell and Shore (scleroscope) methods were plotted against composition. The Brinell curve showed an increase of hardness over the range 100 to 88 per cent. copper. From 88 to 72 per cent. copper the hardness was constant, a slight fall setting in at about 72 per cent. copper and persisting to 63 per cent., at which point a rapid increase set in with the appearance of the beta constituent. With the exception of a small dip in the curve between 53 and 50 per cent. copper the increase is maintained to 45 per cent. copper.

The changes of scleroscopic hardness with composition are of a similar character to those revealed by the Brinell test, but less pronounced, whilst over the range 60 to 53 per cent. copper, no increase of hardness is shown, such as that shown by the Brinell test. This would indicate a very slight difference, scleroscopically, between the beta and alpha phases. The top faces of the bars as cast are slightly softer than the bottom faces, owing to slower rate of cooling, and although this difference is diminished by annealing, it is not entirely eliminated in every case.

The annealed bars (containing 100 to 57 per cent. copper) were cold-rolled, the reduction in thickness being approximately 50 per cent. The hardening capacity of the alpha brasses under cold-work increases rapidly with increase of zinc up to a maximum in the neighbourhood of 75 per cent. copper. The rolled strips, after close annealing, were again tested for hardness, the results confirming those obtained on the bars as cast and annealed, with the exception that the range of uniform hardness is slightly restricted and the succeeding fall (between 70 and 63 per cent. copper) is more pronounced.

Summary of Paper on "THE HARDNESS OF THE BRASSES AND SOME EXPERIMENTS ON ITS MEASUREMENT BY MEANS OF A STRAINLESS INDENTATION," by F. W. HARRIS, M.Sc., presented at the Annual Autumn Meeting of the Institute of Metals, held in Swansea, Friday, 22nd September, 1922.

The object of this research was to make a careful study of the hardness of the brasses; and the theoretical conceptions surrounding the question of hardness and its relation to constitution were first discussed. For performing the tests, it was decided that the Brinell machine would be the most suitable apparatus to use in this instance.

Before the main research was commenced, preliminary investigations were carried out in order to become fully cognisant with, and to measure the effect of, the various factors influencing the hardness. These experiments suggested the possibility of obtaining a value for the fundamental hardness of a material before strain set in.

The theories generally advanced with regard to the connection between hardness and internal constitution have been in the main substantiated. There are certain anomalies, however, which can only be explained by adopting a modified idea of the existing constitutional diagram.

A slight maximum was shown in the middle of the alpha phase, and a small depression in the beta phase.

A curve was established showing the "absolute" hardness for the series, as compared with the Brinell hardness. This latter curve was found to agree in general form with the ordinary one, but was somewhat less sinuous.

The author's curves show a general agreement in type with those of other workers, and confirm the maximum in the alpha phase shown by Meneghini and Turner and Murray, although throughout the series they are considerably lower in hardness value than those of the latter.

BRITISH ASSOCIATION.

SECTION B—CHEMISTRY.

PART II.—SOME RESEARCH PROBLEMS IN THE CARBOHYDRATES.

STARCH

(WITH MR. JOHN MACDONALD, M.A., B.Sc.)

(Continued from Page 170.)

Turning to the problem of the constitution of starch, we encounter very much the same difficulties as have already been referred to under the heading of cellulose. The importance of the compound, its manifold technical applications, and the special appeal its study makes to the biologist have alike combined to produce a voluminous and somewhat scattered literature. If, however, we eliminate unsupported or contradictory results the following evidence as to structure emerges. Starch, when purified from constituents containing nitrogen and phosphorus, possesses the formula $(C_6H_{10}O_5)_x$, and the molecule consists entirely of glucose units. Further, three hydroxyl groups are present for every six carbon atoms, but, as in the case of cellulose, this does not necessarily imply that each glucose residue contains three unsubstituted hydroxyl groups, or that their distribution is symmetrical. The primary reaction of starch, which must be accommodated by a structural formula, is the production of maltose by the action of diastase.

The first essential is the identification of the unit of which the starch molecule is composed, and here, as in the case of other polysaccharides, molecular weight determinations give results of doubtful value. At the present time there is little tendency to regard starch as a highly complex glucoside in which a large number of hexose residues are mutually condensed together, and the view prevails that the polysaccharide is derived from a comparatively simple anhydro-sugar by profound polymerisation. Attention may be focussed on three formulæ based on such ideas.

The unit of starch has been claimed to be:—

1. β -glucosan (Pictet)¹⁹
2. anhydro-maltose (Karrer)²⁰
3. triamylose (Pringsheim)²¹

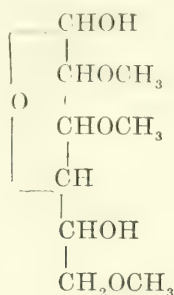
It is possible to test these views by the methylation method.

The first successful methylation of starch was effected by Denham and Woodhouse,²² and the reaction was afterwards adopted by Karrer.²³ He was, however, unable to complete the alkylation, the substitution being arrested, as we ascertained many years ago, when the methoxyl content was of the order 35 per cent. This value is slightly higher than that demanded for a dimethyl starch, but is considerably lower than that calculated for a trimethyl derivative. It is significant that Pringsheim encountered similar difficulty in methylating the amyloses, diamylose giving a tetramethyl compound, whilst α -tetramylose was converted into the corresponding octamethyl derivative. Pringsheim's combined results lead him to the conclusion that the molecule of starch is built up of not more than 4.6 glucose residues, and, on the whole, he is disposed to retain triamylose as the basis of the polysaccharide.

On the other hand, Karrer's view that starch is a polymerised anhydro-maltose rests upon very insecure evidence. The claim that the action of acetyl bromide on the amyloses gives practically quantitative yields of heptacetyl bromo-maltose has been adequately repudiated by Pringsheim. It is, moreover, possible to dispose completely of Karrer's formula for starch by the results now submitted.

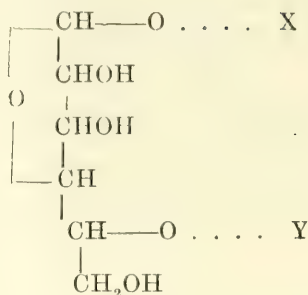
When the polysaccharide is methylated repeatedly by the methyl sulphate method, the reaction ceases when the methoxyl content is 37 per cent. It is to be noted that this maximum is not reached when the silver oxide and methyl iodide reaction is employed, as the substitution then stops definitely at the dimethyl stage. Now, the higher value for methoxyl corresponds exactly with the theoretical amount calculated on the basis that one hexose residue has acquired three methyl groups, while four are shared by two glucose residues. Ultimate analysis is also in agreement with this view. Hydrolysis of the methylated starch has shown that this is not a fortuitous coincidence, and we thus obtain a direct clue to the magnitude of the unit which goes to form the starch molecule.

When digested with methyl alcohol containing hydrogen chloride the methylated polysaccharide was converted into trimethyl methylglucoside and dimethyl methylglucoside. These were purified by distillation in a high vacuum, and thereafter hydrolysed to give the parent sugars. A totally unexpected result was encountered in that the trimethyl glucose actually isolated proved to be the crystalline form in which the methyl groups occupy the 2,3,6-positions. This sugar has been shown to have the constitution given in Formula XIV., and the linkage of one glucose unit in the starch molecule is thus established (Formula XV.). It is to be noted that this particular type of structure is not present in maltose, but is characteristic of cellobiose and lactose.

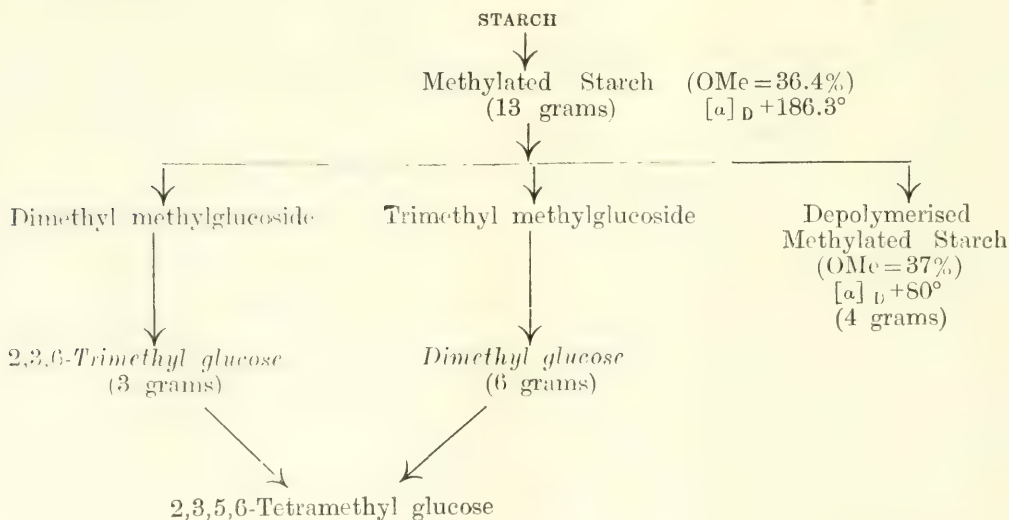


XIV.

XV.



In order to accommodate the formation of maltose from starch either one or two additional glucose residues must be present at X and Y in the unit. Before developing a formula which will fulfil the above conditions an outline of the reactions involved may be given:—



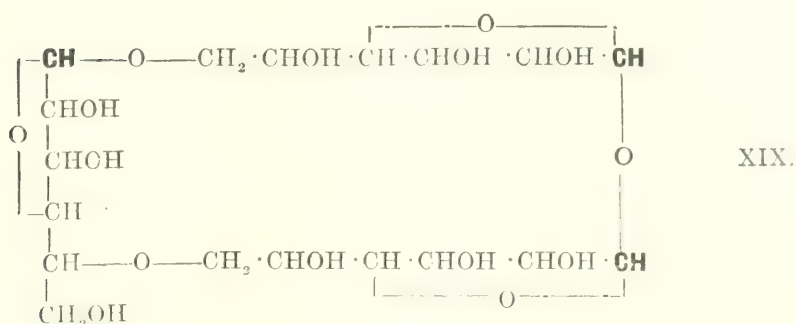
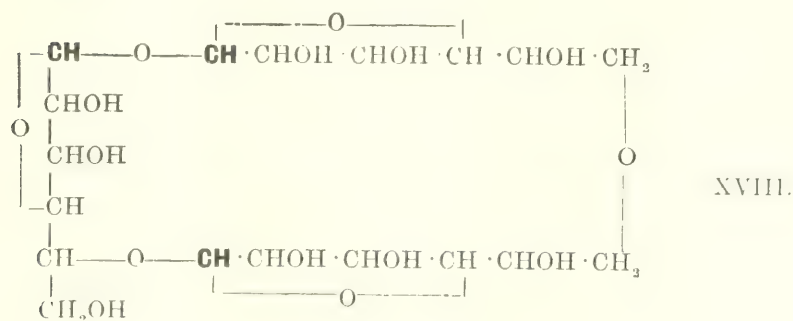
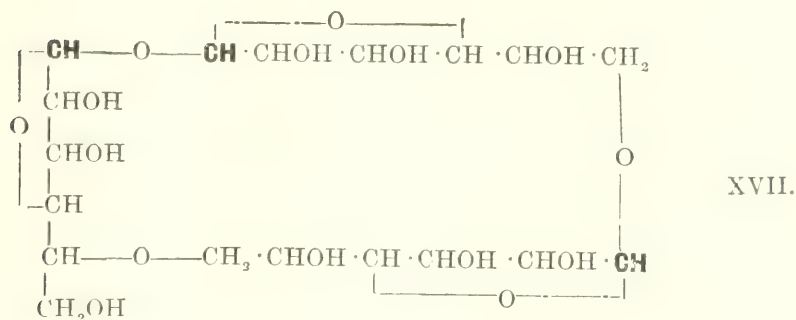
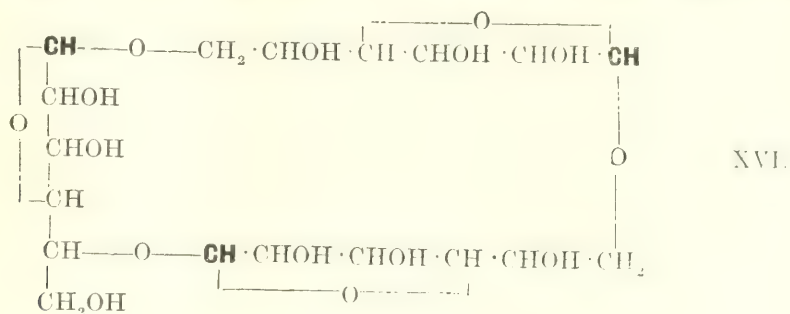
It will be seen that the removal of trimethyl glucose and dimethyl glucose in the molecular ratio of 1:2 is effected without alteration in the composition of any

methylated starch which survives hydrolysis. The result is striking confirmation of the view that starch is based on an anhydro-trisaccharide in which two hexose

residues are linked in a different fashion from the third. One of these is constituted as in Formula XV., and the remaining two must be added in such a way that

at least one pair displays the essential structure of maltose:

Four different structures may be built up to accommodate these factors:—



(Letters in block type designate the potential reducing groups.)

The methylation process cannot discriminate between these possibilities, and with the data at our disposal it is inadvisable to make a definite claim in favour of any one of them. Each formula postulates that starch is derived entirely from the butylene-oxide form of glucose, and this we have shown to be the case. The formulæ are all consistent with the steric hindrance encountered in completing the methylation of starch, previous experience having shown that the alkylation of position 5 is difficult when position 6 of the glucose chain is already substituted.

The formulæ differ in one important respect, as maltose may be obtained from form XVI. in two ways, and in only one way from each of XVII., XVIII., XIX. Pending the completion of further work on this subject we prefer formula XVI., but recognise that our results apply only to a purified rice starch.

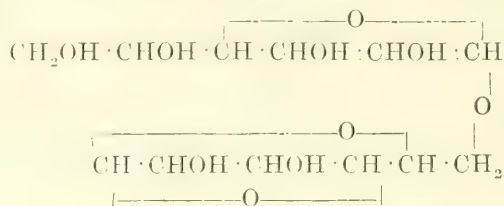
One objection may, however, be discussed. In the formation of maltose no more than one molecule of this disaccharide could be obtained from one such unit. The maximum yield of the sugar would therefore be of the order 70 per cent. (74 per cent. calculated as maltose hydrate). Yields higher than this figure are quoted in the literature, but it may be remarked that most specimens of maltose do not behave as identical homogeneous chemical individuals in bacteriological tests. Further, von Euler and Svanberg,²⁵ who conducted the diastatic hydrolysis of starch under conditions in which the optimum hydrogen ion concentration was present, report that the yield of maltose formed is then 75 per cent. The small margin unexplained by our formulæ may be due to the synthetic action of the enzyme on the molecule of glucose liberated during hydrolysis. This suggestion is in agreement with von Euler's observation that the end point of his reaction was reached with extreme slowness. Another objection to the new structure is that the acetolysis of starch might result in molecular rupture in such a manner that cellobiose would be produced. So far, this disaccharide has not been encountered in the degradation products of starch, a result which is not surprising in view of the uncertainty attending the formation of cellobiose. It may also be mentioned that if starch is composed uniformly of the above anhydrotrisaccharide residues, it is difficult to explain the existence of polyamyloses other

than those to which the general formula $(C_6H_{10}O_5)_n$ can be applied. Taking into consideration the yield of di- and tetraamyloses obtained from starch, it is evident that they may possibly be accounted for in the fraction of the starch molecule which has not yet been converted into recognisable glucosides, but the alternative is also open that the polyamyloses may not all be structurally related to starch.

It is perhaps advisable to point out that the experimental results now presented demand the rejection of various formulæ for starch proposed from time to time by Karrer. His structures are based on a diamylcse (anhydro-maltose), two formulæ for which have been put forward differing in the position of the anhydro-ring. The evidence he adduces in favour of these views is not convincing.

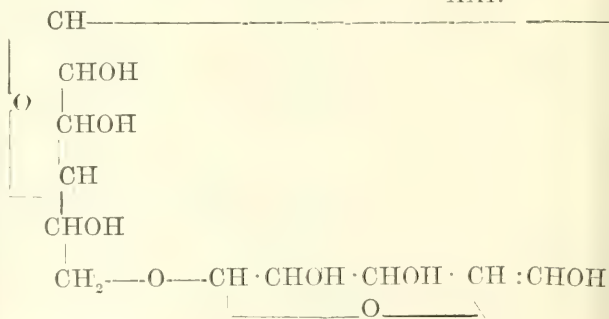
The first unit he gives is:—

XX.



A formula of this type is open to many criticisms, and would demand the direct production of 2,3,5,6-tetramethyl glucose from a methylated starch. It is needless to state further objections, as Karrer rapidly changed his views in favour of an alternative which is equally incorrect. The unit he prefers at present is:—

XXI.



It is clear that the only trimethyl glucose to which such a structure could give rise is the 2,3,5-form described by Irvine and Oldham.²⁶ No trace of this com-

pound was detected by us, and, moreover, the 2,3,6 variety of trimethyl glucoside actually obtained cannot possibly be accommodated by Karrer's formula. For similar reasons it can no longer be maintained that starch is an aggregate of β -glucoside residues. Irvine and Oldham have proved that glucoside is convertible into 2,3,5-trimethyl glucose, and the same sugar should be formed on hydrolysing methylated starch if there is any structural relationship between glucoside and the polysaccharide. The result obtained is obviously opposed to such a view.

Our work has also thrown light on various other problems connected with the chemistry of starch, including the attachment of nitrogen and phosphorus to the molecule. These elements do not appear to be constituents of extraneous compounds, but form part of the polymerised aggregate. This is shown very clearly by the behaviour of nitrogenous starch, which was methylated in the first instance by the use of methyl sulphate and alkali. Thereafter the product was treated with silver oxide and methyl iodide, but contrary to expectation the whole of the material became converted into an insoluble additive compound with silver iodide. This behaviour does not extend to a purified starch, and finds an exact parallel in the case of glucosamine derivatives which, under identical conditions, form insoluble complexes with silver halides.²⁷ Obviously if nitrogen were present merely as part of an adventitious impurity only this component would be removed in the course of the silver oxide alkylation, and the fact that the total material was precipitated is a proof that the fragment containing nitrogen is definitely polymerised to the starch unit. Similar considerations apply to the case of glycogen and have served to complicate our work on the alkylation of this compound. It has been established, however, that, as in the case of starch, the methylation of glycogen shows a tendency to be arrested when the methoxyl content is under 40 per cent. The separation of the methylated glucosides is not yet sufficiently far advanced to permit of their identification, but a publication on the exact relationship of glycogen to starch will not be long delayed.

SYNTHETIC DEXTRINS.

(With Mr. J. W. H. Oldham, B.A.)

With the courteous permission of Professor Pictet we have applied the methyla-

tion process to the synthetic dextrans recently prepared by him.²⁸ These compounds are formed by the polymerisation of β -glucoside and, in properties and composition, they closely resemble the natural dextrans. It is, however, abundantly evident that the synthetic compounds differ structurally from starch as, although methylation was extremely tedious, complete alkylation was effected with the production of trimethyl derivatives. Contrary to expectation, hydrolysis of these compounds did not lead to the formation of 2,3,5-trimethyl glucose, although this sugar has already been obtained from β -glucoside by similar treatment. On the other hand, large quantities of 2,3,5,6-tetramethyl glucose were invariably formed, together with lower methylated glucosides in which the position of the alkyl groups is unknown. It follows from these results that the synthetic dextrans are complex polyglucose-glucosides, and it is interesting to note that they thus conform to the structural type suggested for cellulose by Hess. Although starch is convertible into glucoside and this, in turn, into the synthetic dextrans, it is evident that profound structural alterations must accompany each change.

INULIN.

(With Dr. Ettie S. Steele, Mr. G. McOwan, M.A., B.Sc., and Miss M. I. Shannon, B.Sc.)

The statement has been made that, of all the polysaccharides, inulin is the representative of which the structure has been most definitely established. The opinion is gratifying, but not altogether accurate.

Inulin is derived from fructose, and, until recently, there was no reason to doubt that the parent hexose was the well-known *laevo*-rotatory form of the ketose. This view is no longer tenable as, although inulin itself yields the normal form of fructose on hydrolysis, trimethyl inulin is converted into a *dextro*-rotatory trimethyl fructose. In similar manner, dimethyl inulin gives a *dextro*-rotatory dimethyl fructose. Each of these alkylated ketoses was proved to be a derivative of the " γ -fructose," which is a constituent of sucrose.

This result places inulin in a position which is quite unique, and the evidence is conclusive that the polysaccharide is entirely composed of γ -fructose residues, each of which retains three hydroxyl groups.

The many problems involved in the constitution of inulin have been discussed by us at some length in recent papers, and attention may now be restricted to the additional evidence we have secured. One important point left unsettled was whether the trimethyl γ -fructose obtained from trimethyl inulin is a single chemical substance or a mixture of isomerides. The question is fundamental, as only in the event of the methylated fructose proving to be a single individual are we justified in claiming that the hydroxyl groups in inulin are symmetrically disposed. The experimental difficulties in the way are formidable, as methylated fructoses of the γ -type are liquids and give no crystalline derivatives. By the following method, however, it has been possible to obtain the necessary information, and it is now established that only one form of trimethyl fructose is produced from inulin.

A large quantity of trimethyl inulin was digested with methyl alcohol containing hydrogen chloride under conditions which effected:—

- (a) Depolymerisation,
- (b) hydrolysis,
- (c) condensation to give trimethyl methylfructoside.

The product was distilled in a high vacuum, and fractions were abstracted at frequent intervals while the boiling-point remained constant. All the fractions showed the same refractive index and specific rotation. Moreover, the speed of hydrolysis of the fructoside, as indicated by polarimetric observations, was in each case the same and in each experiment the trimethyl fructose then formed showed identical physical constants. Of greater importance is the fact that all the specimens of trimethyl methyl-fructoside reacted in the same way when dissolved in acetone containing hydrogen chloride. Under these conditions trimethyl fructose monoacetone was formed, and here again the speed of the reaction measured polarimetrically showed no difference in any of the specimens.

There can be no doubt, therefore, that inulin is an aggregate of anhydro γ -fructose residues and that each of the units is identical.

As the exact structure of the methylated fructoses of the γ -type is not yet determined with certainty, it is needless to speculate here on the manner in which

these residues are united. The subject has been engaging our attention for a considerable time, but is complicated by the readiness with which the methylated inulins undergo both polymerisation and depolymerisation.

It is not unlikely, bearing in mind the structure assigned to cellulose and starch, that inulin is based on a tri-anhydro- γ -fructose.

The structural discussion which I have had the honour to lay before you on one of the most important groups of natural compounds is admittedly incomplete, and no claim is made that the formulæ now submitted are final. But they at least indicate a new development in the chemistry of polysaccharides, and lines of further research are opened out which promise in time to reveal the intimate constitution of these substances. Much reliance has been placed on the validity of the methylation process as a means of determining structure, but it has to be remembered that most speculation of the kind on carbohydrates is now based on results obtained by this one particular method. The structure of glucosides, the nature of γ -sugars, the constitution of sucrose, maltose, and cellobiose, are all involved in current discussions on this subject, and all are based on the properties of the simple alkylated sugars.

Numerous details, such as the specific reactions of the individual hydroxyl groups in carbohydrate units, have still to be settled before the further problem of the polymerisation of polysaccharides can be adequately dealt with, but many features, for the most part unexpected, have been revealed.

The polysaccharides, like many other research fields, are, after all, not so complicated as they appeared when viewed from afar, and the close relationship now established between cellulose and starch, starch and lactose, inulin and sucrose, will, it is hoped, play a part in bringing within the range of exact experiment the structural study of all types of natural compounds related to the simple sugars.

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BRITISH ASSOCIATION.

FUEL ECONOMY.

(Continued from Page 174.)

Low Temperature Carbonisation of Coal as a Future Source of Oil Fuels.—Therefore, it has to be recognised that the most promising internal supply of both motor spirit and fuel oils lies in the direction of the low-temperature carbonisation of coal, provided that methods can be devised for same which are sound both from the technical and the commercial points of view. A really successful solution of this problem is greatly to be desired, not only for the aforesaid reasons, but also because it would be a great factor in the abolition of the smoke nuisance, especially from domestic fireplaces. The Committee has paid close attention to the recent developments with regard to this matter which are taking place in this country. In this connection attention may be drawn to:—

1. The description of the operation of the experimental plant at Barugh, near Barnsley, as published in *Engineering* of October 28, 1921.

2. The Conference on low-temperature carbonisation which was held at Cardiff on April 20, 1922, under the auspices of the South Wales Institute of Engineers.

3. The paper read on April 3 last, on "The Influence of Structure on the Combustibility and other Properties of

Solid Fuels," by Messrs. E. R. Sutcliffe and E. C. Evans, before the London section of the Society of Chemical Industry (*Journ. Soc. Chem. Ind.*, Vol. xli., p. 196 T.).

4. The Report on Low Temperature Carbonisation recently issued by the Fuel Research Board (H.M. Stationery Office, 1922).

Taken together, these publications give a fairly comprehensive view of the present position of affairs in regard to the low-temperature carbonisation in this country. The Committee is in general agreement with the view recently expressed by the Fuel Research Board that, although we have not yet reached the stage when a final answer can be given to the question whether or not it will be possible to establish on sound industrial lines a new industry based on the carbonisation of the tens of millions of tons of coal per annum which are at present being consumed in the raw state in this country, yet as the result of the pioneering work which has been done during recent years by various organisations such knowledge and experience has been gained as affords some ground for the expectation that we are approaching a conditional solution of the matter.

There still seems to be some difference of opinion as to whether from the commercial point of view it will be better to carbonise at temperatures round about 600° C., or at somewhat higher temperatures (say, 700° C. to 750° C.), but this may be regarded as a minor issue. It seems now to be established, as the result of fairly large scale trials, that the average yields of the various products now obtainable by carbonising suitable British bituminous coals at a temperature of 600° C. will amount (on the weight of the dry coal carbonised) to about 7.5 per cent. of tars, and about 2.5 gallons per ton of motor spirit, besides about 3,500 cubic feet per ton of a rich gas of a gross calorific value (say) of about 800 B.Th.U.s.,^a and a 70 to 80 per cent. residue of smokeless semi-coke.

2 The Fuel Research Board's Report gave figures which would average about 1,000 B.Th.U.s., but the Committee has thought it better to adopt the more conservative estimate of 800 B.Th.U.s. here.

Seeing that the cash value of the semi-coke residue far exceeds that of all the other products put together, and also that the price of fuel oil in this country will probably also be determined by circumstances beyond our control, it seems as though the ultimate prospects of a low-temperature carbonisation industry will depend upon the price which the public will be willing to pay for a smokeless domestic fuel. There can be little doubt but that such a fuel, properly manufactured, is a very suitable one for domestic consumption; it burns freely and smokelessly, and also, according to Dr. Fishenden's recent experiments (*vide* Fuel Research Board Special Report No. 2) it has a greater radiant efficiency than either coal or high-temperature coke. Its general adoption, however, will probably depend upon two other conditions being fulfilled. Firstly, it must be prepared and distributed in a form which will allow of its being freely handled without undue disintegration. Secondly, if its ash content could be cheaply reduced to a low figure by subjecting the coal to some washing process such as froth flotation or the like before it is carbonised, its attractiveness as a domestic fuel would be undoubtedly greatly increased. Indeed, it seems possible that public opinion might soon be educated to regard with favour well-manufactured smokeless semi-coke of better combustibility and of smaller ash content than raw coal.

From this point of view, the recent work of Sutcliffe and Evans upon the influence of porosity on the combustibility of solid fuels (*loc. cit.*) is of interest, inasmuch as it draws attention to a factor whose significance is not always sufficiently recognised in fuel technology. These authors consider the porosity of the cell walls of a carbonised fuel to be extremely important in determining its combustibility. Their suggestion that, before the coal is carbonised for the production of a free-burning smokeless domestic fuel, it should be finely pulverised and briquetted by pressure without the use of a binder, in order that the thermal availability of the resulting semi-coke may be raised to a higher level, deserves further investigation from both the technical and commercial standpoints, especially if it could be found practicable to combine it with some preliminary washing process in order to reduce the ash content of the semi-coke.

Supposing that further technical developments result in the establishment of a low temperature carbonisation industry for the manufacture of a smokeless domestic fuel, it is of interest now to forecast the effect of such developments upon the future home supplies of motor spirit and fuel oils. It may be provisionally assumed that the amount of coal which could be so carbonised to supply domestic fuel requirements would be at least 30 (and possibly even 50) million tons per annum. Taking the former of these two figures, this would mean a possible production of about 100 million gallons (or about 350,000 tons) of motor spirit, and 600 million gallons (or about 2,750,000 tons) of anhydrous tars (fuel oils).

(To be continued.)

"THE DYERS' BIBLE."

BRITISH USERS' NEW RECORD OF COLOUR COUNTRIES: A TIE IN ANGLO-GERMAN RIVALRY.

(From a Scientific Correspondent.)

After being held up for a couple of months by the printers' strike, the first instalment of the new "Dyers' Bible," or, to give it its official title, "Colour Index," has been published this week by the Society of Dyers and Colourists of Bradford, under the editorship of Dr. F. M. Rowe, of the Manchester College of Technology, assisted by Mr. C. Lea, M.Sc. Tech., and a large revision committee, on which the leading dyestuff manufacturers and dyestuff users of all classes are represented. Amongst professors who have helped forward the production are Professor A. G. Perkin, F.R.S., of Leeds; Professor G. T. Morgan, F.R.S., of Birmingham, and Professor Knecht, of Manchester.

One hundred and fifty copies of the proofs have also been revised by colour manufacturers everywhere with the exception of Germany. "We used every possible means to persuade Germany to come in, too," said Dr. Rowe in an interview, "but apparently after a meeting of all their dyestuffs manufacturers they refused."

"It may be remembered," Dr. Rowe went on, "that Schultz's 'Farbstofftabellen,' which the Index is intended to replace, was regarded as such an important

book that when it was scarce during the war the Americans made a photographic copy of it and circulated it throughout the United States. The 1914 Schultz reckoned to include by name all the commercially made dyestuffs of which the constituents, method of preparation and properties were public knowledge. Since 1914 the whole situation has, of course, altered. The full working capacity of our dyestuffs industry is now round about 35,000 tons a year. The United States are not far short of that total, whilst the old-established Swiss firms have developed their resources, and a number of colour works have also been established in France and Italy.

"As a result many firms are now placing on the market dyes which may not be new, but at least have completely new names, and one of the points of the Colour Index is to include all the alternative trade names under which the dye is marketed attached to the particular composition of the actual chemicals concerned.

"We have brought up-to-date all the scientific and patent literature references, and made them as complete as possible. Clearly, it is important for a dye-user who requires a particular dye to be able to look it up in such a Colour Index under any name by which he has known it in the past, and to find there a complete list of the manufacturers who now place it on the market.

"It has taken us one year to get out the first part, but meantime sufficient matter for ten parts has been prepared for the printer. All told, there will be full particulars of about 1,400 individual colours, or 400 more than in the last edition of Schultz, and there will be included quite a large number of dyes which have never figured before in a work of this kind. It is surely an indication of the change in the world situation regarding dyestuffs that in 1922 a British society should be publishing a work of this nature which, it is anticipated, will supersede German reference books."

The dyes dealt with are those manufactured by more than one hundred dye-makers all over the world. Belgium, Holland, Spain, Russia and Czecho-Slovakia are represented by one firm apiece, and other countries in their order are: Japan 2, Italy 2, Switzerland 5, France 17, United States 29, Germany 32, Great Britain 32.

GENERAL NOTES.

MINISTRY OF AGRICULTURE AND FISHERIES.

RURAL PARTY LINE TELEPHONES.

The Ministry desires to call the attention of farmers and others to the facilities now offered by the Postmaster-General for the co-operative use of a telephone service, which, from several points of view, should prove of very great value to residents in rural districts.

The Postmaster-General has issued a memorandum on this subject, in which it is stated that residents in rural districts are apt to think that a telephone is a luxury of town life which it is impossible to enjoy in the country except at a high cost. This is true if each person requires a separate exchange line, consisting of two wires over the whole distance between the exchange and his residence, to be provided for his exclusive use, but such a line is not necessary in order to enjoy most of the advantages of the telephone service. If a sufficient number of subscribers living on or near a country road leading to a town where there is a telephone exchange will agree to use one line, they can telephone as much as they please to people on that exchange for a moderate fixed charge which ranges from £4 to a little more than £4 10s. according to the number of subscribers per mile.

CO-OPERATIVE SELLING OF EGGS.

£15,787,034 SPENT IN FOREIGN EGGS
IN 1921.

The people of this country paid the enormous sum of £15,787,034 in the year 1921 for imported foreign eggs, exclusive of imports from Ireland, which country exported in 1920 (mainly to Great Britain) eggs to the value of £14,307,720. There is no reason why the greater part of this money should not have been spent in the purchase of eggs produced at home. One of the best means of encouraging the increased production of eggs is to form Co-operative Egg and Poultry Societies.

From the Report of the Government Chemist upon the work of the Government Laboratory for the year ending March, 1922, we learn that the total number of samples examined in the course of the year, including those dealt with at the Chemical Stations, is 302,562, as compared with 308,675 in the preceding year, a decrease of 6,113.

ADMIRALTY

Chemical work is performed for the Admiralty in connection with the Contract Department at Whitehall, the Naval Yards, the Engineering Department, the canteen inspections, the hospitals and schools, and the Medical Branch. The Contracts Branch of the Admiralty submitted 89 samples of foods on tender for report as to conformity with specification and opinion as to relative merits. The technical examining officers at the victualing yards forwarded 290 samples from supplies and from returned stores for examination and report, many of the samples being submitted with the object of preventing the issue of canned goods contaminated with metals.

Other samples to the number of 311 included ferrous and non-ferrous metals, fuel oils for boats, rubber washers and valves, soaps, fabrics for sail cloths, and paints.

The total number of samples for the Admiralty was 690.

CHEMICAL STATIONS.

In order to avoid delay in the examination of samples, chemical stations have been established at the more important seaports and one inland town of the United Kingdom, where samples are tested by Customs and Excise officers who have been specially trained at the Government Laboratory for this purpose.

As a check on the work of these officers, the residues from a certain number of samples tested by them are retested at the Government Laboratory. The number of such retests during the past year was 1,277. The results indicated that the testing work at the outport chemical stations is performed in a highly efficient manner.

HYDROMETERS, SACCHAROMETERS, AND GRADUATED VESSELS.

Hydrometers, for ascertaining the strength of spirits, and saccharometers, for use at breweries and glucose factories, are tested as to their accuracy, and graduated vessels of various descriptions for use in the Surveying Department are calibrated at the Laboratory before being issued to the officers of Customs and Excise. During the past year 3,008 such tests were made. In addition, three Sikes' hydrometers were tested for the National Physical Laboratory by comparison with the Revenue standard instruments deposited in this Laboratory.

Forty-six samples of imported manufactured tobacco and snuff were submitted for classification as to the proper tariff description and rate of duty chargeable if found to be admissible. Seventeen were found to contain prohibited ingredients, which rendered them inadmissible for importation.

Of home-grown leaf tobacco, which is being experimentally cultivated in Ireland, East Anglia, and the south of England, 74 samples were examined. Government assistance is furnished to the growers in certain districts, and recent information on the progress of the experiments is contained in the Journal of the Department of Agriculture and Technical Instruction for Ireland, Vol. XXI., page 200, and the Eleventh Report of the Development Commission, pp. 49-50.

DISPOSAL BOARD.

A number of steel and bronze bars was examined for this Department in order to facilitate grading. The recovery of radium from one batch of luminous dials, gun-sights, etc., was completed, and upwards of 300 milligrams of radium bromide in a state of purity exceeding 90 per cent. was obtained. In addition to this, some 100 milligrams of highly concentrated material was recovered in a state suitable for immediate use. All this reserve of radium is likely to be put to its proper use and will assist investigations.

POWER GAS FROM SEWAGE.

The Birmingham, Tame and Rea District Drainage Board, in their report last week, make the following statement, which is of interest to the works manager and chemist alike, as to the practical application of gas, derived from sewage, for power purposes. As a result of experiments, it has been found possible to drive a pump which lifts sewage from the well adjoining the engine house to the irrigation land. The gas available for driving the engine has varied in amount, but it has been possible to keep the well free of sewage, although a gas holder for storage purposes had not been erected. The experiment is regarded by the Board as holding great possibilities of further expansion, but the economic aspect is a matter for further consideration.

CANADA'S EXCELLENT HARVEST:
WORLD'S CEREAL PRODUCTION.

The Canadian Government communicates by telegram to the International Institute of Agriculture new data as to the production of cereals, which show an increase on the already favourable estimates made previously. In fact, the production this year will be far greater than last year's and amongst the highest yet recorded. The production reaches 10.6 million metric tons of wheat (a 70 per cent. increase on the average during the five years 1916-20), 1.3 million metric tons of rye, 1.7 million metric tons of barley, and 8.6 million metric tons of oats.

MANCHESTER LITERARY AND
PHILOSOPHICAL SOCIETY.

THE COMMITTEE OF THE CHEMICAL SECTION,
ELECTED MAY 5TH, 1922.

Chairman, Leonard E. Vlies, F.C.S., F.I.C.; Vice Chairman, H. F. Coward, D.Sc., F.I.C.; Secretary, David M. Paul, B.Sc., A.I.C.; Committee: David Bain, D.Sc., W. H. Bentley, D.Sc., F.C.S., David Cardwell, M.Sc., F.I.C., R. H. Clayton, B.Sc., J. A. Russell Henderson, D.Sc., F.C.S., Harold Moore, M.Sc.Tech., F.C.S., A.I.C., Rona Robinson, M.Sc., F.I.C., F. C. Thompson, B.Sc., D.Met., J. C. Withers, Ph.D., A.I.C.

Meetings are held monthly during the session from October, 1922, to May, 1923.

CORRESPONDENCE.

NUMERICAL RELATIONSHIP BETWEEN THE
ELEMENTS, STRONTIUM, TIN, AND CHLORINE.

TO THE EDITOR OF THE "CHEMICAL NEWS."

SIR,—In the issue of your paper of Jan. 27th, containing the description of the numerical relationship between calcium and strontium, it is pointed out that tin and chlorine are related as number and logarithm to the Napierism base, following a rearrangement of atomic numbers with respect to 1106.

In the following study, an attempt is made to understand the nature of the relation between tin and chlorine, while adhering closely to the systems of atomic numbers in use. The atomic number of chlorine is 35.46137 when the logarithm to the base ten is 1.5497556, that of Sn.119 being 0755470. The logarithm of chlorine is the association of the first figures of the logarithm of chlorine, and practically the logarithm of tin following the first cipher.

Let Na.(23) be the number of Cl., then the logarithm of Cl. is 0.737783. Twice 2737783 (*Chem. News*, July 8th, 1921) and the constant 13 gives 13547556. This is equal to $2 \times 46 \times 147256$.

($O. = 16 \cdot \log_e 256 = 94001.$)

$147256 : 8 = 2300875. \text{ Log. } 230087 =$

3618932.

$618932 = \log. 1.290124 \times 5594546 \text{ (Fe.)}$

$119 \times 147256 = 1752346 = 2 \times 876173.$

$\text{Log. } 1752346 = 2436202.$

$123 \times 147256 = 18112488 = 2 \times 9056244.$

The logarithm of 18112488, 2579782 is related to the equivalent weight of iron, 27972, with the interpolated five or with the constant 13.

10.13 is the atomic number of chlorine, on the system Ca. = 11.45 (*Chem. News*, Jan. 27th).

Let Sr. = 905625, Na. = 24.3326.

Sodium is now the horizontally adjacent element magnesium. From this examination it follows that 119 and 123 are closely related, sodium 23 and chlorine 35.46, being the atomic numbers with which the relationship is established. When Sn. = 226.45, the number 123 is then 234.063, calculating on Sn. = 119, and log. Sn. (119) is 34062 calculating on 123. It is opportune, here, to advocate the adjustment of the present system of atomic weights to the one of Cl. = 35.5. Co. = 59031.—I am, Yours, &c.,

A. SAKOSCHANSKY.

NOTICES OF BOOKS.

A Systematic Qualitative Chemical Analysis, by G. W. SEARS, Ph.D. Pp. VI. + 119. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd., 11, Henrietta St., W.C.2. 1922. Price 8s. 6d.

This contribution to the literature of Analytical Chemistry is divided into three parts, with an appendix on the preparation of reagents, etc.

Part I. is introductory, and deals in a clear manner with the Ionic Theory and the Law of Mass Action, with special reference to their application to the methods of Qualitative Analysis.

A systematic scheme for the separation of metals (cations) is described in Part II. It has many original features, thus Group I. includes not only the cations Pb, Ag, Hg, but also Bi and Sb, since ammonium chloride is used as the group reagent. Again Group III. includes Al, Cr, Zn, Mn, Fe, Co and Ni, separated into an Aluminium division and an Iron division, the former including Al, Cr, and Zn. It seems doubtful whether this arrangement is altogether satisfactory.

In Part III. a new method is given for the identification of acids (anions). An attempt is made to follow the procedure of metal analysis, since one sample is used and the acids are separated into four groups by precipitation methods. In this way 25 acid radicals (anions) may be detected, and are classified into the following groups:—

I. Anions whose Ag- salts are insoluble in cold dilute nitric acid.

II. Anions whose salts decompose on boiling in acid solution and give volatile oxides.

III. Anions whose Ag- salts are soluble in acid but insoluble in warm neutral solution.

IV. Anions whose Ag- salts are soluble.

The author does not lose sight of the fact that Qualitative Analysis is a part of General Chemistry and under the guidance of a teacher well acquainted with his scheme, students might quickly acquire, not only the principles of analysis, but also of general chemistry from the standpoint of the Ionic Theory. J.G.F.D.



This list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 23427—Buckman, R. H.—Liquid-metering apparatus. Sept. 1.
- 23571—Calvert, G.—Manufacture of substances containing a methyl radicle. Aug. 30.
- 23561—Farbwerke, L.—Manufacture of methane. Aug. 30.
- 23441—Hansen, I. J.—Method of treating containers, etc., of iron for manufacture of sodium peroxide. Aug. 29.
- 23473—Jacobson, B. H.—Manufacture of anhydrous metal chlorides. Aug. 30.
- 23362—Klipstein & Co.—Process of manufacturing derivatives of carbazols. Aug. 29.

Specifications Published this Week.

- 184501—Jackson, W. J.—Process for treating ores.
- 184527—Dosssett, J. M.—Process of and apparatus for crystallizing copper sulphate.
- 165085—Anon. de Produits Chimiques Etablissements.—Process for the production of acetaldehyde from acetylene.
- 184625—Imray, O. Y.—Manufacture of dialkyl-amides of nicotinic acid
- 184627—Johnson, J. Y.—Manufacture and production of oxalic acid.
- 184639—Harris, H. — Apparatus for refining metals.

Abstract Published this Week.

Alkaloids. — Patent No. 182986. — Messrs. Howards & Son, of Uphall Works, Ilford, Essex, have obtained a Patent for a process for obtaining Amino derivatives of Hydrocinchona Alkaloids. They are obtained by reducing the corresponding nitro compounds in neutral or nearly neutral solution. Suitable reducing-agents are metals in the presence of a solution of a salt, for example zinc or iron in presence of ammonium sulphate, tin and an ammonium salt, and hydrogen sulphide, the nitro compound may be dissolved in alcohol, or dissolved in water as a salt. In an example nitrohydroquinine hydrochloride is reduced with iron filings and ammonium sulphate solution at 100° C.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3260

AN APPEAL ON BEHALF OF RUSSIAN MEN OF SCIENCE.

Chemical Society,
Burlington House,
Piccadilly, W.1.

28th September, 1922.

DEAR SIR.—In September of last year, in consequence of the information received as to the deplorable conditions under which Russian men of science were placed, I issued an appeal to the Fellows of the Chemical Society to assist in the alleviation of the acute distress prevailing amongst their colleagues in Russia.

I have to announce with great satisfaction that in response to this appeal the sum of £214 2s. 7d. was received, besides numerous valuable parcels of clothing, underclothing, boots, and books. It will be seen from the statement given, that of this sum, £170 has been devoted to the purchase of clothing, which has been distributed amongst our colleagues in Ekaterinburg, Moscow, and Petrograd. In addition to this, three cases containing clothing and books have been despatched to Moscow and Petrograd.

The difficulty with which we were confronted, namely the uncertainty as to whether parcels sent from England would reach their proper destinations, has now happily been overcome, definite proof having been received in every case that the goods have reached those for whom they were intended.

In a letter written by one of the workers of the European Student Relief Society to the Friends' Relief Committee, the following passage occurs:

"The Chemical Society in England recently sent out some scientific journals, etc., through the Friends. They have been entrusted to me for distribution, and when I told some of the Moscow Professors of their arrival, their eagerness to see them was like the eagerness of the children in the famine areas to get bread. You can assure all donors that every journal would be properly circulated in the faculty concerned and be retained in the library."

It will be seen from this how urgent the need still is for scientific books; and from

information received from the Committee of Russian Men of Science (a member of which visited this country last Spring) the need for every kind of scientific apparatus appears to be equally pressing.

Notwithstanding the useful work that has been accomplished by the different organisations formed to relieve the wants of men of science in Russia, there remains much to be done, for there is every reason to fear that the necessity will be no less acute during the coming winter than it was last year. I therefore issue this appeal to Fellows of the Chemical Society, and to British chemists generally, to render every assistance within their power, in the confident hope that a generous response will be forthcoming.

In addition to donations of money to be devoted to purchasing requisite articles, gifts of clothing (which, if used, must be in good condition), and recent chemical literature, will be welcome. The Chemical Society will continue to act as the receiving depot, and cheques (made payable to Mr. S. E. Carr, and crossed "Russian Fund"), together with parcels of clothing, boots, books, etc., should be addressed to the Assistant Secretary, The Chemical Society, Burlington House, Piccadilly, W.1.

Yours faithfully,

JAMES WALKER.

President.

BRITISH ASSOCIATION.

FUEL ECONOMY.

(Continued from Page 188.)

Present Tendencies in the Use of Oil Fuel.—Before the advent of the internal combustion engine, the term "fuel oil" was restricted to an oil intended to be burnt in furnaces and the like. In the early days of oil fuel practice, comparatively light oils were used. They were "atomised" and injected into the boiler furnace or the like by means of steam or air, and the burners used were often of a crude and unsatisfactory character. In recent years, however, more attention has been given to the proper design of such burners, and to the more effective combustion of the fuel oil. The consumption of air or steam by the oil burners has been considerably reduced, and, as they have attained a higher degree of mechanical

efficiency, heavier oils have been successfully used in them. Methods have now been devised whereby heavy oils may be sprayed into the furnace under pressure alone, without the aid of either steam or air; and, therefore, it has become possible for heavy petroleum residues, such as asphaltum, to be employed as first-class fuels for land installations. A similar tendency has recently been manifested in the use of fuel oil in internal combustion engines. Until very recently petroleum refiners prepared a very light fuel oil for these engines, but mechanical research is now being directed in order to render them capable of burning even the heaviest oils. Progress in this direction has been greatly helped by scientific investigations upon the spontaneous ignition temperatures of fuel oils. The outstanding question to-day is how to adapt a heavy fuel oil for use in low compression internal combustion engines; this is now receiving the close attention of scientific investigators, and it may be hoped that as a result of their work the public will in due course be enabled to use heavy fuel oil in the place of motor spirit.

III.—THE CHEMISTRY OF COAL.

Progress towards the solution of the problem of the constitution of coal substance can be recorded, notwithstanding the magnitude and complexity of the problem. The difficulties arise in no small measure from the absence from the products of such researches of bodies with crystalline habit or other well-defined physical characters by which the chemist is accustomed to identify the compounds he isolates. Still, the literature shows the subject has attractions for not a few chemists who, employing various methods of attack, seek to obtain information as to the nature of the multifarious compounds which go to the make-up of coal. As, however, different investigators select for their study coals of varying origin and of different classes, it is not always easy to compare the results obtained.

The work of Clark and Wheeler (*Trans. Chem. Soc.*, 1913, 103, p. 1704), combining the application of solvents with the study of the action of heat upon the extracts of the coal so obtained, has undoubtedly given much useful and valuable information. The results, however, still leave open to conjecture and theoretical explanation the true nature of the com-

ponents of the several fractions. The classification of the coal components by Clark and Wheeler based upon the pyridine-chloroform treatment is too facile; nor could it be expected to provide material for a complete explanation of the properties of coal.

The breaking down of a bituminous coal by treatment with a mixture of pyridine and amyl alcohol yields an extract from which, by successive use of ether and light petroleum, Bone, Pearson, Sinkinson, and Stockings (*Proc. Roy. Soc., A*, vol. 100, 1922, p. 582) have succeeded in obtaining (1) a non-resinous wax-like substance, (2) a resin, to which the formula $C_{31}H_{32}O_3$ is assigned, (3) a portion, insoluble in ether, consisting of non-resinous material, partially dissolved by alcoholic potash, and this they designate as "humic substance." The authors are satisfied that these humic substances are not "resinic" but "cellulosic" in origin. The influence of these several fractions on the coking of a coal has been studied, with the result that, whereas the said resin is in part responsible, the main cause of the coking propensities was shown to be a series of substances of "humic" type which are soluble in chloroform but not in ether, and whose fusion temperatures are below those at which they undergo rapid decomposition.

The acidic substances extracted by alkalis from the aforesaid humic bodies are precipitated by acids from these solutions, as bulky, dark-coloured, opaque jellies. These jellies, on drying, form black, brittle, lustrous, and structureless masses, with conchoidal fractures, suggestive of the material forming bright coal which Stopes has styled "vitrain." The consideration of these facts has led Bone and his co-workers to suggest that "bright coal" may have originated in a colloidal gel.

In this connection attention may be directed to a like conclusion arrived at by Dr. J. A. Smythe in 1906, in a paper read before the University of Durham Philosophical Society,* which dealt with certain Peaty Deposits from a Pit-Fall at Tantobie, County of Durham. Amongst the substances described is a black jelly-like body, which Smythe styled "black-stuff," and this he showed by its composition and

* *University of Durham Philosophical Society Proceedings*, Vol. 2, pt. 6.

behaviour to solvents, notably to pyridine, suggests a similar relationship to bright coal.

It has long been recognised that bituminous coals contain three easily distinguishable components, which until recently had usually been designated (a) "mother of coal" or "mineral charcoal," (b) "dull hard coal" (Ger. = "Matzkohle"), and (c) "bright coal" (Ger. = "Glanzkohle"), respectively, the last named being a structureless, lustrous substance with a conchoidal fracture. Recently Stopes (*Proc. Roy. Soc.*, B. 90 (1919), p. 470) proposed new names for them, namely (a) *fusain*, (b) *durain*, whilst (c) is termed by her either *clarian* or *vitrain*, according as it does or does not contain recognisable plant tissues and structures. In putting forward these proposals Stopes recognised that none of the four said ingredients (with the possible exception of vitrain) are either homogeneous or chemical molecular units; also that they do not even approximately represent the crystals in a petrological section of a rock. Provided that such qualifications are kept clearly in mind, and that it be realised that clarain may prove to be merely vitrain in which plant structures occur in suspension, the Committee sees no great objection to the provisional substitution of the proposed new names for the older ones, regarding the matter more as one of convenience than as involving any new principle.

The Committee also feels that the growing practice among coal-chemists to use the terms, *alpha*, *beta*, *gamma*, etc., to designate the several components obtainable from the coal substance by fractional extraction of it by means of various solvents, is one which, unless regularised in some definite way, is likely to lead to much confusion and obscurity, to the detriment of progress. It is obvious that coal may be "fractionated" in as many different ways as there are suitable solvents and modes of applying them; and therefore unless, as the results of some particular treatment or procedure, components of a reasonable degree of purity and well-defined properties are isolated, it is undesirable that definite names should be assigned to them, as though they were the actual chemical constituents of the coal instead of unknown mixtures of them. The Committee, therefore, would suggest that the time has come when chemists should agree in conference upon some common plan of labelling such

"coal fractions" which, whilst recognising them to be such, shall also in some way indicate how they have been obtained.

Supposing, for example, that a particular investigator extracts a coal with two solvents A and B, he might designate the fraction which is insoluble in both as the α AB fraction, whilst β AB might be used to denote the fraction which is soluble in A but not in B, and the γ AB that which is soluble in both A and B, assuming all solvents to be used at their respective boiling points at atmospheric pressure. Thus, a fraction termed the " *α pyridine-chloroform*" fraction would mean the residual insoluble portion of a coal after successively extracting it with pyridine and chloroform at their respective boiling points; the " *β pyridine-chloroform*" fraction would be that portion of the pyridine extract which is insoluble in chloroform; whilst the " *γ pyridine-chloroform*" fraction would mean the portion of the coal which is soluble in both pyridine and chloroform, and so on. In cases where the coal is extracted at some particular temperature other than the boiling point at atmospheric pressure of the solvent employed, the actual temperature employed might be designated by putting it in small type above the name of the solvent, thus, "*-benzene¹²⁰*," denoting that benzene had been used at 120° C.

IV.—BROWN COALS AND LIGNITES.

Although Great Britain itself is almost destitute of sub-bituminous coals and lignites (the Bovey Tracey deposit in Devonshire being the only important one in this country), the problem of using them efficiently is of great importance to several of the Dominions, and especially so to Australia, Canada, and India. Of the total estimated Canadian reserves, amounting altogether to 1,234,268 million tons, no less than 1,072,627 million tons are of a sub-bituminous lignitic class occurring in the upper cretaceous formations of the province of Alberta, whilst in the neighbouring province of Saskatchewan there are both cretaceous and tertiary lignite reserves amounting to 59.182 million tons. The Dominion Government has set up a Lignite Utilisation Board for the purpose of investigating the best means of utilising these resources, and it is hoped that the approaching meeting of the Association at Toronto in 1921 will afford an opportunity of discussing the problem in all its bearings.

In Australia, the provincial Governments of Victoria, South Australia, and New South Wales are all interesting themselves in the utilisation of their brown coal and lignite resources. Of these, the celebrated Morwell deposits in the Gippsland district of Victoria, which are of phenomenal thickness without parallel elsewhere in the world, are of great scientific interest, as well as of economic importance for the future of Australia. It has been estimated that within an area of 50 square miles in the Latrobe Valley, and within 1,000 ft. of the surface, there are 31,144 million tons of the coal. A bore-hole put down near Morwell disclosed no fewer than seven beds of brown coal within 1,000 ft. of the surface, of a total thickness of 781 ft., the individual seams (taken in order from the surface) running 29 ft. 8 in., 25 ft. 8 in., 23 ft., 227 ft. 10 in., 265 ft. 6 in., 166 ft., and 43 ft. 8 in. respectively. So far as they have been examined, they were reported by the Victorian Advisory Committee on Brown Coal, in 1917, as consisting of "a matrix of earthy brown coal, with sporadic inclusions of lignite . . . the matrix consists of pollen grains, spore cases, and decomposed vegetable matter. . . . The coal varies in colour between yellowish brown and black, but it always pulverises to brown powder." The raw coal usually contains about 50 per cent. of water; the *dry* coal contains: Carbon = 62.5, Hydrogen = 4.85, Nitrogen = 0.45, Sulphur = 0.20, Oxygen = 28.00, and Ash = 4.00 per cent. Its gross calorific value is about 5,600 K.C.U.s. per kilogram.

In the year 1917 the Advisory Committee appointed by the Victorian Government to investigate the possibilities of generating electric power on a large scale from the Morwell coal reported that, notwithstanding its low grade, power could be more cheaply generated from it for the City of Melbourne than from black coal imported from New South Wales. It has been officially estimated that the cost of producing raw Morwell coal at the mines will not exceed 2s. 6d. per ton. The Victorian Government has already authorised the expenditure of £6,000,000 upon the development of the Morwell coal deposits in the expectation that by the year 1924 electrical energy from thence will be supplied, not only to the City of Melbourne, but also throughout the whole State of Victoria. It has been calculated that the

cost of such energy at the mine will be as low as £2 17s. 6d. per horse-power per annum, and that it can be sold profitably to manufacturers throughout the State at an average price of £4 8s. per horse-power per annum. Large-scale steam trials are, or have been, in progress with a view to ascertaining how the coal may best be burnt under boilers, and a large electric power-station scheme at Morwell is rapidly materialising, and a large order for water-tube boilers in connection therewith has recently been placed in this country.

The problem of how such low-grade fuel as brown coals and lignites can be most efficiently burnt in boilers has therefore become one of great importance. It is obvious that a prime condition of efficient combustion is that coal shall be dried before being burnt; and as this drying can be effected at the expense of some of the sensible heat in the waste gases from the boiler, provided that they contain not less than 10 per cent. of carbon dioxide, such a drying operation may be cheaply carried out as an integral part of the boiler operation. Whether or not, as an addition to such drying operation, the coal should be subjected to a preliminary low-temperature carbonisation, using the residue therefrom as the boiler fuel, is a matter for future investigation to decide. In this connection attention may be drawn to the recent discovery made by Bone (*Proc. Roy. Soc., A.*, vol. 99, 1921) whilst investigating Morwell brown coal, Saskatchewan and other typical lignites:—

(a) that there is for each particular brown coal or lignite a certain definite temperature limit (usually between 300° C. and 400° C.) up to which it may be heated (in the *dry* state) so as to effect a considerable chemical condensation in its cellulosic or humic constituents, with simultaneous expulsion therefrom of steam and carbon dioxide, together with a small but variable proportion of carbonic oxide; and that such chemical condensation is unaccompanied by any other change productive of either hydrogen or hydrocarbons;

(b) that, by means of such condensation, substantially the whole of the potential energy of the fuel may be correspondingly concentrated by suitable heat treatment (within the prescribed

temperature limit) in the resulting carbonaceous residue, which may therefore be burnt with greater calorific intensity than the original coal; and

(c) that, accordingly, such treatment constitutes a possible means of "upgrading" brown coals and lignites generally, thus improving their fuel values.

RECLAIMED RUBBER.

A paper on "Reclaimed Rubber" was read by Dr. J. Torrey at a meeting of the Manchester Section of the Institution of Rubber Industry, held on Monday, Sept. 18th. Mr. H. Mandelberg presided.

Dr. Torrey said the reclaimer was at this time confronted with an unexpected and a very critical economic problem. For twenty years reclaimed rubber had played a significant part in the manufacture of rubber goods in Great Britain. Economic conditions had now reduced enormously the amounts used, but the manufacturers who had been purchasers were not indifferent to the changed conditions, and it was fitting that the reclaimer should suggest how the relation which had hitherto existed between the manufacturers and the reclaimers should be conserved.

Circumstances had made the United States the foremost reclaimers and users of reclaimed rubber in the world. The grades of scrap rubber handled were few in number. From the start the tendency had been to put on the market a few standard reclaimed rubbers, each representing a product reclaimed from a definite grade of scrap. There was very little blending or mixing. The output was large, and the long uninterrupted runs on the same grade of scrap made for low manufacturing cost and uniform quality. In Great Britain the reclaiming industry had a totally different history. There had been no standardisation; the whole tendency was towards individualisation. One company had in its formula books a hundred separate and distinct reclaimed rubbers, and the analysis of any month's sales would show 38 to 42 grades. The reason for this strong individualisation was that reclaimed rubbers were additions, and must fit in with other ingredients, which usually meant the concocting of a special stock. A day's run often consisted of from five to even eight or ten stocks, and as a rule the quantities of each were not

large. This tended to increase manufacturing costs, and made it more difficult to attain uniform quality.

What was required now was a method capable of dealing with scrap rubbers containing cotton fabric. The chemicals used must be cheap and abundant, the processes continuous, the machinery simple, necessary labour reduced to a minimum. The question of separating and recovering the cotton as well as the rubber substance had always been in the minds of reclaimers, but there had been good and sufficient reasons why it had not become prominent. The rubber substance had a competitive chance in the market; the cotton certainly had not. With regard to the problem of fabric destruction, none of the solvents for cellulose had proved useful. The conditions under which satisfactory solution could be effected were too exhausting and too easily disturbed. Then again, unless the chemical was practically valueless there must be a means of recovering as much as possible to use again. The only two reagents that had proved themselves available were dilute sulphuric acid and caustic soda solution, either concentrated or dilute. The former was effective at boiling point under ordinary atmospheric pressure, but the caustic soda process required closed vessels and fairly high temperatures, usually about 360° F. Both processes were effective and simple. The free sulphur which the scrap rubber contained must be removed if present in ordinary quantities, and this was accomplished by the alkali process at the same time that it destroyed the fabric. The acid process did not do this; therefore it must be supplemented by an alkali treatment to remove the free sulphur, or a scrap must be employed which contained very little free sulphur. Usually the second alternative was adopted, and the most suitable scrap was rubber shoes. It was doubtful whether a finer, all-round reclaimed rubber had ever been produced than the high-class American shoe stocks and the equally useful Russian shoe stocks which were so prominent in pre-war times. The only American reclaimed rubbers that had ever gained a real foothold in this country were those shoe stocks.

In America reclaimed rubber was the staple material in many classes of goods; other substances, such as rubber, minerals, oils, etc., were added to it. In Great Britain the reclaimed rubber was itself an

addition only, and must fit in with the other substances to produce the desired results as to cost and quality. This made the task of the reclaimer a difficult one, but nevertheless reclaimed rubber made steady headway and won a place for itself. The fluctuations in the price of raw rubber had little effect on the demand, and the prices quoted and paid for reclaimed remained practically constant, while raw rubber fluctuated from 2s. 6d. to 10s. per lb. Now all was different. To-day the best crepe could be bought at about 7½d. per lb. What inducement then was there to use reclaimed rubber? It was steadier in price and quality than plantation rubber. It was an effective and safe accelerator of vulcanisation. It was almost impossible to injure it on the mill. It was valuable in tubing machine work. Time was saved in the milling and the vulcanisation. Labour was saved, especially if each class of reclaim went into the kind of goods from which it was reclaimed. If manufacturers resumed the use of it in anything like a whole-hearted way, it would be because it was cheaper to use, and the goods required were produced with less trouble and with less expenditure of time, care, and labour. But this argument was not accomplishing much now, and years might pass before the effect was really significant. Meanwhile the reclaimer could not go on indefinitely catering to a fragmentary and sporadic business. There was no sign of any decided rise in the price of rubber, and the chances were not good of being able to reduce the cost of the reclaimed rubber by the recovery and utilisation of the cotton mixed with the rubber substance. There remained the probability of some new and extensive line of manufacture, such as rubber tiles or blocks for roadways, flooring and roofing. Here the wearing and weather resisting powers of reclaimed rubber would come in, and the labour saving would count very decidedly. It was difficult, however, to see any solution of the problem without some decided change in the general business situation. Most of the grades of scrap rubber were to-day not worth the cost of collection and transportation; much less were they worth reclaiming.

THE CONSTITUTION OF ALUMINATES.

By JAROSLAV HEYROVSKY, D.Sc. (LOND.),
Ph.D. (PRAGUE).

The acidity of aluminium hydroxide is greater than it might appear from ordinary analytical experience. For the determination of its acidic strength, however, the precipitated hydroxide must not be used, since it "ages" quickly, i.e., loses reactivity besides occluding other matter. The alkaline solutions show the highest and definite degree of neutralisation in which aluminium hydroxide reacts in the "nascent state," being just formed by the action of the solution on metallic, preferably amalgamated aluminium. Thus solutions of aluminates result, which are, in the absence of carbon dioxide, at the room temperature and decinormal dilution not more than 1.5 per cent. hydrolysed.

From the physico-chemical investigations of such solutions it is obvious that aluminium hydroxide reacts as a typically mono-basic acid, being similar in this respect to boric or arsenious acid (compare *Trans. Chem. Soc.*, 1920, CXVII., 1013, and *Rozprawy České Akademie*, 1921, XXX., No. 27).

In order to investigate the monobasicity of the "aluminic acid" further, the researches were extended to the solutions of alkaline earths (*Bulletin de l'Académie des Sciences de Bohême*, 1922, No. 25, by J. Heyrovsky, H. Kadlecová, and K. Stoklasová). The cryoscopic method of Noyes and Whitney (*Zeitsch. Phys. Chem.*, 1894, XV., 693) was used, and in some cases conductivity measurements and analysis of the solutions were studied.

MAGNESIUM AND CALCIUM.

The aluminates of these metals are only slightly soluble. Into a saturated solution of magnesium oxide (*Kahlbaum's puriss.*) of specific conductivity 1.11×10^{-4} mho. (at 25° C.), amalgamated aluminium foil was dropped. After the dissolution, the conductivity decreased to 0.273×10^{-4} mho., and remained constant, showing that the solubility of magnesium aluminate is about one-third of that of the hydroxide.

Similarly, a solution of pure calcium oxide of specific conductivity 8.30×10^{-3} mho. (at $25^{\circ}\text{C}.$) showed after the dissolution of aluminium a decrease to 1.90×10^{-3} mho.; simultaneously white foils of the calcium aluminate separated out.

The cryoscopic examination of a lime solution showed $0.087^{\circ}\text{C}.$ lowering; after the dissolution of aluminium this decreased to $0.028^{\circ}\text{C}.$ Thus the solubility of calcium aluminate appears to be one-third of that of lime.

STRONTIUM.

In a 0.057 normal strontium hydroxide solution, small pieces of aluminium foil were dissolved, and after each dissolution the lowering of freezing point was observed.

gram-atoms Al. dissolved per litre.	specific conductivity at $0^{\circ}\text{C}.$	lowering of freezing point.
0.	6.745 10 mho.	0.119°C
0.0206	4.855	0.120
0.0313	3.927	0.120
0.0428	2.909	0.120
0.0626	1.880	0.120
0.0759 (decomposes)	4.137	0.125

The decrease of conductivity with increasing aluminium contents is quite regular and linear until the atomic ratio of $\text{Al} : \text{Ba}$ is $2 : 1$, which indicates that no other ions than monovalent anions substitute the hydroxyl ions in neutralisation.

After the spontaneous decomposition of the fully saturated solution, the conductivity reached the same value as has been observed in the half-saturated solution, containing one atom of aluminium to one atom of barium; hence the hydrolysis in this final solution is 50 per cent.

Another set of measurements was made with a 0.186 normal baryta solution. Here the lowering of freezing point was $0.380^{\circ}\text{C}.$, and gradually changed to 0.363° in the solution, which was most saturated with aluminium hydroxide. Analysis of this solution gave, after several weeks' standing, the ratio of atoms of $\text{Al} : \text{Ba}$ as $0.97 : 1$.

CONCLUSIONS.

The slight changes in the lowering of freezing points and the regular fall of conductivity observed in solutions of alkalies as well as alkaline earths, when gradually saturated with aluminium-hydroxide in the nascent condition show that in dilute solutions (below decinormal) only monovalent aluminate ions exist. In contact with

The results were as follows:—

gram-atoms Al. dissolved per litre.	lowering of freezing point observed.
0.	$0.159^{\circ}\text{C}.$
0.005	0.170
0.011	0.175
0.050	0.172
0.056	0.176

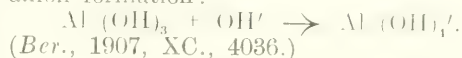
After several weeks the solution was analysed, and the atomic ratio of $\text{Al} : \text{Sr}$ found as $0.90 : 1$.

BARIUM.

A 0.0605 normal solution of barium hydroxide was gradually saturated with aluminium, and corresponding conductivity changes and cryoscopic readings were observed. The results are:—

crystalline aluminium hydroxide all these solutions are about 50 per cent. hydrolysed, with nascent aluminium hydroxide the hydrolysis is only 1—1.5 per cent.

The process by which aluminium hydroxide dissolves in alkalies is undoubtedly that suggested by Pfeiffer, viz., complex-anion formation:—



From this point of view aluminium hydroxide is not an acid, which could neutralise an alkaline solution by its hydrions; it removes hydroxyl ions by forming complex anions with them just as other compounds do, when redissolving in excess of reagents, e.g., $\text{Ag}(\text{CN})_2^-$, HgI_4^- . It neutralises not by its acidity but by its affinity for hydroxyl ions. The hydrolysis of aluminates is then not effected by the scarcity of hydrions due to "aluminic acid," but by the incompleteness of the complex formation.

The explanation given in analytical textbooks as if aluminium hydroxide could send into solution one, two or three of its hydrogen atoms as ions, and thus to react in a manner analogous, say, to phosphoric acid, does not agree with the experimental evidence mentioned in this paper, and ought to be rejected.

Since 4 and 6 are the co-ordination numbers of aluminium, its complex anions are of the type AlX_4' and AlX_6''' ; this would not exclude the possibility of aluminate ions $Al(OH)_6'''$ in most concentrated solutions. Experimentally, in dilute solutions,

only $Al(OH)_4'$ ions were detected.

*The Chemical Department of the
Charles University, Prague.
September 25, 1922.*

BRITISH ASSOCIATION.

(SECTION K—BOTANY.)

TRANSPORT OF ORGANIC SUBSTANCES IN PLANTS.

ADDRESS BY PROFESSOR H. H. DIXON,
Sc.D., F.R.S., PRESIDENT OF THE SECTION.

Plant physiologists have not paid the attention to the transport of organic substances which the importance of the subject appears to deserve. The ascent of water in high trees in defiance of gravity strikes the casual observer and forces him to speculation as to how it is contrived; but the problem of the transmission of organic substances throughout plants only forces itself on those who are more or less conversant with some of the leading facts of vegetable physiology.

Among physiologists the usually accepted view is that organic substances are distributed throughout the plant by means of the bast. The wood also acts as a channel of distribution for these substances to opening buds and developing leaves, especially in spring when root-pressure is active. The sap of bleeding contains appreciable quantities of these substances, and their distribution to the developing buds in spring by means of the wood was recognised by Hartig and Sachs. Fischer showed that even in summer many woody plants contain reducing sugars in their wood. The sugar content of the wood is at a maximum in spring, diminishes in summer, and is at a minimum in winter; at the end of February it rises rapidly. There is a second crest on the curve at leaf-fall. Dr. Atkins and myself extended Fischer's observations, and showed that appreciable quantities of soluble carbohydrates, sucrose, hexoses, and even maltose, are found in the tracheæ of the stems and roots of many trees at all seasons of the year. Being

in the tracheæ they must be carried from the lower parts to the upper growing regions, including the cambium of the stem. Samples drawn from different levels during the spring were found to have a greater concentration at higher levels. The inflow of water below, and consequent dilution, is probably largely responsible for this difference. Towards the end of the season there is no marked difference.

This upward transport of carbohydrates in the tracheæ seems to be accompanied with smaller amounts of proteins. Thus Schroeder showed that the quantity of proteins in the bleeding sap rises and falls with the quantity of sugar.

This view that the rising current in the tracheæ carries organic substances in it and distributes them to the growing regions has lately been impugned. It was pointed out that in many cases ringing close below the terminal bud prevents the development of that bud because the wood is unable to transmit sufficient supplies of organic substance. As Strasburger has already pointed out, this interpretation rests upon the fallacy of supposing that the removal of the bark as far as the cambium leaves the wood uninjured. As a matter of fact, microscopic examination of the wood, from which the outer tissues have been stripped, shows that its tracheæ soon become blocked with air-bubbles and with substances probably exuded into them and their walls during morbid changes in the cells of the cambium, in the cells of the medullary rays, and in those of the wood-parenchyma. The blocking is accompanied with discoloration, and is most apparent in the outer layers of the wood. It is only reasonable to suppose that the efficiency of the tracheæ as channels of transmission is seriously impaired even before there is visible evidence of plugging.

It is evident that this clogging may act differentially on the water and the substances it carries in it. In the first place, the whole cross-section of the wood is available for the transport of water, while probably the outer layers are mainly utilised by the organic substances. Further, colloidal deposits in the walls, and especially in the pit-membranes, would obstruct the passage of organic substances much more than they would the water which carries them. These considerations readily explain how it is that, while the water-supply to the buds of ringed branches is adequate, the supply of organic substance may be deficient.

Apart, then, from the very slow movement of organic substances from cell to cell, there is very cogent evidence that their upward motion is effected in the tracheæ of the wood. There is no reason to believe that during this transport the walls or pit-membranes of these tracheæ oppose the passage of the dissolved carbohydrates or of the simpler proteins any more than the water which conveys them. Hence the velocity of transport of these organic substances is that of the transpiration current, and the amount conveyed in a given time depends on the velocity and concentration of the stream.

The transport of organic substances in an upward direction in plants is secondary, for, as is well known, carbohydrates certainly, and proteins most probably, are manufactured only in the upper green parts of plants—principally in the leaves, and must be transported in the first instance back from these to the stems to be distributed to the growing regions and to the storage organs.

It is almost universally held that the channel for this backward or downward motion of organic substances from the assimilating organs is the bast of the conducting tracts. The orthodox position is summed up by Strasburger as follows: In woody plants the carbohydrates manufactured by the leaves pass downwards in the bast. Movements of carbohydrates in the opposite direction in this tissue only take place if they are occasioned by local consumption. From the bast the carbohydrates spread into the medullary rays and wood-parenchyma, and in young branches fill these tissues and more or less of the pith. A downward movement in the wood-parenchyma, such as was formerly held, does not take place, and in those conifers in which there is no continuous wood-parenchyma is anatomically impossible. In spring and also during summer-growth an upward transport of carbohydrates in the water tracts occurs.

This view that the channel for the backward and downward movement of organic substances is afforded by the bast received great support from Czapek's work published in 1897. By section of the conducting tracts in one half of the petiole he showed that depletion of the corresponding half of the blade was delayed. He also showed that only where vertical bridges connected the upper and lower portions of bark in ringed stems were the effects of

ringing nullified. Oblique and zigzag bridges are ineffective. Thus transverse conveyance in the stem is negligible. The parallel and longitudinal arrangement of the elongated elements in the bast seemed to him to provide adequately for the observed longitudinal passage. Their narrowness and large colloid content did not present themselves as difficulties.

He also recorded the observation that the blades of leaves, the petioles of which had been killed by jacketing them with steam, did not become emptied of starch. Similarly, when the petioles were killed with chloroform-vapour, depletion was arrested. Again, anæsthetisation of the petiole, by surrounding it with a watery solution of chloroform, greatly delayed the disappearance of starch. On the other hand, depletion was not obstructed when the petiole was immersed in a 5 per cent. solution of potassium nitrate. From this last observation he concluded that plasmolysis of the translocating elements does not interfere with their function as channels of transport.

Czapek formed no definite theory as to how organic substances were moved in the past. He was sure that the transport depends on living protoplasm. He did not consider that the streaming of protoplasm contributed materially to the motion, seeing that streaming does not occur in mature sieve-tubes. He regarded the sieve-tubes as the most important elements in the transmission of these substances, because the deposition of callus in the sieve-plates synchronises with the stoppage of transport. The transport, according to him, is not simply due to diffusion. He supposed the protoplasm to take up the organic substances and pass them on. If diffusion does not account for the passage from one particle of protoplasm to the next, it would seem that we must suppose the organic substance to be projected from one to the other.

These observations and their interpretation by Czapek have strengthened the opinion that the bast is the channel for the downward transport of organic substances. It is remarkable how little weight has been attached to the damaging criticism of Czapek's views by Deleano, especially as those views are so unsatisfactory from a physical standpoint.

The latter author showed that it is inadmissible to compare externally similar leaves, which often behave, so far as de-

pletion is concerned, very dissimilarly. He also pointed out that without any export a leaf may be depleted of all its starch within thirty-five hours, and partially anticipated an extremely interesting recent observation of Molisch—namely, that transpiring leaves lose their carbohydrates much more rapidly than those whose transpiration is checked by being surrounded with a saturated atmosphere. Neglect of these facts led Czapek into error. Deleano also showed that organic substances continue to leave the blades even after the petioles have been killed by heat or by chloroform-vapour. The rate of depletion is reduced by the former agent to about one-third, and by the latter to one-half. If this observation is substantiated it would show that the intervention of living elements is not essential for the transport. He further found that the blades attached to petioles which were surrounded by chloroform-water lost their starch more quickly than those immersed in water.

The contradictory conclusions of Czapek and Deleano urgently call for a reinvestigation of the points at issue. It is not enough to assume, as Schroeder does, a completely sceptical attitude towards the latter investigator's account of his experiments. If Czapek's work holds good, we will have to regard the bast, and especially the sieve-tubes, as the channels for the transport of organic substances back from the leaf-blades where they are manufactured, and we must look for some hitherto undreamed-of method of transmission through these most unlikely-looking conduits. On the other hand, if Deleano's conclusions are borne out, we should admit that protoplasm is not necessary for the transport, and we would turn to a dead tissue as furnishing this channel.

So far as I am aware none of the earlier investigators made any estimate either of the actual quantities of organic material which are transported or of the velocities of flow in the channels which are necessary to effect this transport.

We may approach this problem from two opposite directions—(1) by dealing with the amount of organic substance accumulated in a given time in a storage organ, or

(2) by using the amount exported from an assimilating organ. The cross-section of the supposed channels of transport and the volume of the solution containing the substances in each case will give us the other necessary data.

For the first method a potato-tuber will furnish an example. One weighing 210g. was found attached to the base of a plant by a slender branch about 0.16 cm. in diameter. In this branch the bast had a total cross-section of 0.0042 cm.². This figure is a maximum; no allowance was made for the cross-section of the cell-walls, or for any non-functional elements in the bast. Now if the bast exclusively furnished the channel of downward transport, all the organic substance in the potato must have passed this cross-section during the time occupied in the growth of the potato. One hundred days would be a liberal allowance. According to analyses more than 24 per cent. by weight of the potato is combustible. Therefore we must assume that during this time more than 50g. of carbohydrate has passed down a conduit having a cross-section of no more than 0.0042cm.². The average concentration of the solution carrying this substance could scarcely have been as much as 10 per cent. (2.5-5 per cent. would be more probable. The concentration of sugar in bleeding sap is much below this figure, and seems never to reach 4 per cent.). Assuming, however, this concentration, the volume of liquid conveying 50g. must have been 500cm.³, and this quantity must have passed in 100 days. Therefore the average velocity of flow through this conduit, having a cross-section of 0.0042cm.²,

must have been $\frac{500}{0.0042 \times 100 \times 24}$ i.e., nearly 50 cm. per hour.

By the second method we arrive at a different figure. Various investigators, from Sachs onwards, have measured the rate of photo-synthesis per square metre of leaf per hour. Under the most favourable conditions the amount may approach 2g., and it has been estimated as low as 0.5g. Taking Brown and Morris' determination for *Tropaeolum majus*, viz., 1g. per square

metre per hour, and assuming one-third of the carbohydrate formed is used in respiration in the leaf, we find that a leaf of 46cm. may form during ten hours' sunshine 0.46g.; during the twenty-four hours one-third of this will be respired, leaving 0.31g. to be transported from the leaf. The volume of the solution (again assuming a concentration of 10 per cent.) will be 3.10cm.³. The cross-section of the bast of the bundles in the petiole was 0.0009cm.², therefore the velocity of flow, if the bast was used as the channel of transport, must

have been $\frac{3.10}{0.0009 \times 24}$ or 140 cm. per hour.

Similar figures to these were derived using measurements obtained from a number of potato tubers and from various leaves. The velocities indicated, even assuming a concentration of 10 per cent., lay in all cases between 20 cm. and 140 cm. per hour. These figures are in agreement with those arrived at by Luise Birch-Hirschfeld, as to the weight of organic material transported from leaves.

A flow of this rate through the bast seems quite impossible. The narrow transverse section of its elements, the frequent occurrence of transverse walls, and the lining of protoplasm and large protein contents practically preclude the mass movement of liquid through this tissue. If we imagine the flow restricted to the sieve-tubes the velocity must be correspondingly increased, and the excessively fine sieve-pores, more or less completely occupied by colloidal proteins, must be reckoned with. Simple diffusion, as Czapek recognised, cannot account for the transport, and there is no reason to suppose that adsorption on the surfaces of the colloid contents of the sieve-tubes can increase the velocity of diffusion, as Manghan suggests.

As soon as one realises the volume of the solution which has to be transported, and the velocity of the flow that this necessitates, one naturally turns to consider if the open capillary tubes of the wood may not be utilised as channels of transport. Deleano's results, indicating that the depletion of leaves continues even after the living elements of their petioles have been killed, support this conjecture.

The emphasis which has been laid on the function of the wood as providing a channel for the upward movement of water usually obscures its function as a downward and

backward channel also. Early experimenters, however, fully recognised that, under certain conditions, the current in the wood may be reversed. Thus Hales quotes several experiments of his own proving this point, and states that some of his were but repetitions of Perault's earlier work. In these experiments Hales showed that water applied at the top of a branch, which is severed from the tree, is drawn back into the branch and supplies its leaves, and makes good their transpiration losses. A tree inarched into two adjacent trees may continue to grow even after its connection with the ground is severed, drawing its supplies from its neighbours. Finally, a forked branch removed from a tree will remain fresh, and continue to transpire water for many days if one limb of the fork with its leaves is immersed in water. There is, of course, recent work also showing this reversed current.

By means of an eosin solution this reversal of the transpiration current may be very easily demonstrated. If the tip of a leaf of a growing potato-plant is cut under eosin solution, the coloured solution is very quickly drawn back into the tracheæ of the conducting tracts of the leaf; from there it passes into those of the petiole, and makes its way not only into the upper branches and leaves, but also passing down the supporting stem may completely inject the tracheæ of the tuber, and from thence pass up into the wood of the remaining haulms of the plant. Its passage is entirely in the tracheæ of the wood of the conducting tracts.

Another very striking experiment may be carried out with the imparipinnate leaf of *Sambucus nigra*. Its petiole is split longitudinally for a few centimetres and half removed. The remaining half is set in a solution of eosin. The solution is rapidly drawn up the wood-capillaries of the intact half-petiole, and soon appears in the veins of the pinnae on the same side of the leaf, beginning with the lowest, and gradually working up into the upper ones. Finally it appears in the terminal pinna. All this while the veins of the pinnae on the other side remain uncoloured. Now, however, the eosin begins to debouch into the base of the uppermost of these pinnae and spreads through its veins; finally it makes its way down the offside of the rachis to the basis of the lower pinnae, and from thence spreads into their veins. In this case we

see very clearly how transpiration actuates an upward current on one side and a downward current on the other. It is interesting to note that if the terminal pinna and its stalk is removed the eosin does not appear in the pinnae of the second side, or only after a considerable time when the small anastomosing conducting tracts are utilised.

Luise Birch-Hirschfeld recently also describes many experiments with herbaceous and woody plants, tracing the path of the reversed current by means of lithium nitrate and eosin.

In all these cases the tension of the sap determines the flow from a source wherever situated, and transpiration from the leaves, or parts of leaves, which are not supplied with liquid water from without draws the water through the plant along the channels of least resistance. Hence it is that if the cut vein of a lateral pinna provides the point of entry, the solution may pass backwards in some of the conducting tracheæ, leaving others quite uncoloured, so that some of the veins only of the pinna are injected. The injected tracts bring the solution down the rachis and petiole into the stem, while a few or many, as the case may be, remain filled with colourless liquid, presumably the sap drawn upward to supply the transpiring surfaces of the leaf. Generally the coloured liquid descends an appreciable distance in the tracheæ of the stem before it begins to rise in the ascending current, mounting to other transpiring leaves. As a rule after some time—depending on the rate of transpiration and the amount of water supplied by the roots—the presence of the coloured liquid may be demonstrated in certain continuous series, or filaments of tracheæ in several bundles of the lower parts of the stems. Similarly, if tubers or rhizomes are present examination of these parts, after a suitable interval, will show that many of their filaments of tracheæ are injected. Meanwhile the parts above the supplying leaf become coloured, and it will be seen that the distribution of coloured tracheæ is decided by the anatomical connections of those filaments of tracheæ which directly convey the coloured liquid from the point of supply through the petiole to the stem. In tracing the path of the solution one is impressed with the fact that the path of least resistance is by no means always the shortest path in the wood. Transverse motion across several tracheæ seldom occurs, and the separate linear

series of conducting tracheæ are practically isolated from each other laterally. Here we may recall Strasburger's experiments showing the very great resistance offered to the flow of water in a transverse direction in the wood of trees. This isolation of the separate filaments of tracheæ in the leaf and in the stem enables the tension developed by the transpiring cells of the leaves, while it raises a column of water in one series of tracheæ, to draw down a solution in a neighbouring filament of tracheæ terminating above in some local supply. If the anatomical connection of the two series is located in a subterranean organ the tracheæ of the subterranean organ may become filled from that supply.

So far the evidence of reversed flow in the water-conducting tracts which we have been considering has been derived from plants under artificial conditions—plants whose conducting tracts have been cut into and otherwise interfered with. Is there any evidence that reversal of the transpiration-current normally occurs in uninjured plants?

Some recent work on the transmission of stimuli seems to me to indicate that these reversals are continually occurring in normally growing plants.

The first piece of work to which I would direct your attention is that of Ricca on *Mimosa*. It has long been known that the stimulus which causes the folding of the pinnules and the bending of the petioles of *Mimosa* could traverse portions of the petioles or stems which had been raised to such a temperature as would kill the living elements in these organs. Notwithstanding that observation, Haberlandt's view, that the stimulus is transmitted as a wave of pressure through certain tubular elements of the bast, was generally accepted as the least objectionable of any of the theories which had been put forward to explain this transmission. Ricca saw that, among other difficulties, the slowness of transmission—never more than 15mm. per second—was a grave objection to this view. Accordingly, working with a woody species of *Mimosa*—*Mimosa Spegazzinii*—he removed the whole bast and outer tissues of the stem for many centimetres—viz., twenty-three—and was able to show that the stimulus was still transmitted. Similarly he found that the stimulus was transmitted through narrow strips of the wood

from which even the pith had been removed. These experiments and others in which the transmitting organ had been killed for a considerable length caused Ricca to recognise that the stimulus is transmitted in the wood and not in the bast, as had been previously held. Thus he was led to assign the transmission to the transpiration-current. He was able to confirm this conjecture by showing that the transmission to the various leaves of a plant is largely controlled by the rate of the transpiration from the individual leaves. Thus, other things being equal, a rapidly transpiring leaf receives the stimulus sooner than a sluggishly transpiring one equidistant from the point of stimulation. He further was able to show that the stimulus may be transmitted through a glass tube filled with water, just as it is transmitted through a dead portion of the stem. Evidently a hormone set free into the transpiration-stream is the long-sought-for mechanism by which the stimulus is transmitted throughout *Mimosa*.

(To be continued.)

GENERAL NOTES.

INTERVIEWS WITH HIS MAJESTY'S TRADE COMMISSIONER AT CAPETOWN.

Major G. Fetherston, D.S.O., M.C., His Majesty's Trade Commissioner at Capetown, is in attendance at the Department of Overseas Trade for a brief period, and will be pleased to interview manufacturers and merchants interested in trade with South Africa. Appointments with Major Fetherston can be made by application to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. The reference, 3032/T.G. should be quoted in all cases.

GERMAN GLASS INSTRUMENT INDUSTRY.

According to the *Berliner Tageblatt*, a community of interests contract has been concluded between the Union of German Factories for Glass Instruments, in Il-

menau, and the Union of Thermometer and Glass Instrument Factories, in Roda. An arrangement has been made with the glassworks Schott und Genossen, in Jena, Gustav Fischer, in Ilmenau, and Greiner and Friedrich, in Stutzbach, that the glass tubes manufactured by these factories shall only be sold to the firms belonging to both Unions.

BOARD OF TRADE ANNOUNCEMENT.

DISTRIBUTION OF REPARATION DYESTUFFS.

The Board of Trade desire to draw the attention of consumers of dyestuffs to the fact that the distribution of such quantities of dyestuffs as are obtained from Germany as Reparation is now being carried out by the British Dyestuff Corporation, Limited, which company has been appointed agent of the Board of Trade in the matter as from the 1st September, 1922, in place of the Central Importing Agency.

This change in agency has been accompanied by certain modifications of the arrangements formerly in force, which it is hoped will prove to the advantage of consumers:—(1) All prices now quoted will include delivery to purchasers' works or stores, and will not be subject to the 1 per cent. commission hitherto charged; (2) such prices will be in respect of 60 lbs., 120 lbs., or 240 lbs. packages (which will be free and not returnable), and a reduction of 1d. per lb. will be made on all purchases of 4 cwt. or upwards, whilst in the case of purchases of not less than 1 ton the standard price will be subject to a reduction of 2d. per lb. On the other hand, purchases of less than 60 lbs. will be subject to an addition ranging from 1d. per lb. in the case of 20 lb. lots to 3d. in the case of 1 lb. lots, to cover the cost of extra packing; (3) at the discretion of the British Dyestuffs Corporation 30 days' credit on all accounts may be given.

In all other respects the British Dyestuffs Corporation will act solely under the direction of the Board of Trade, and will follow the practice hitherto in force of distributing the dyestuffs under their original German denominations and as far as possible in their original packages.

Any additional quantities of dyestuffs which may be received from time to time will be reserved for a period of not less than 14 days for actual consumers, and notification of arrival will continue to be given, as hitherto, through the Colour Users' Association, though in addition lists of stocks held and current prices will be issued periodically by the British Dyestuffs Corporation. The first of such periodic lists will be available in the course of the next few weeks. At the expiry of the period referred to above, during which dyestuffs are reserved for consumers, they will be available to the trade generally.

Prices will continue to be fixed by the Board of Trade, and will be reviewed from time to time in accordance with general market conditions.

All enquiries on the subject should, in the first place, be addressed to the British Dyestuffs Corporation, Limited, Reparation Department, 70, Spring Gardens, Manchester.

CORRESPONDENCE.

TO THE EDITOR OF "THE CHEMICAL NEWS."

SIR,—You will be interested to know that we are opening an office for the benefit of British exporters, at 37, Southampton Street, London, W.C.2.

We shall be glad to give any of your readers information regarding prospects of trade in the United States. Representing as we do, over 7,000 of the leading wholesale and importing houses in America, firms dealing exclusively in goods from foreign countries, we are in a unique position to offer this valuable service to your readers.

We take this opportunity of pointing out that this service is offered free of all cost, as it falls within the scope of our activities which are solely concerned in advancing the sale of imported commodities through-out the U.S.A.

We trust it will be to our mutual benefit for this information to be given your sub-

scribers through the pages of your esteemed paper.

We remain,

Yours faithfully,

THE AMERICAN BOARD OF FOREIGN
TRADE, INC.

New York, September 15, 1922.

The Department of Commerce, Bureau of Standards, Washington, U.S.A., has recently placed the following pamphlets on sale:—

A new revised edition, the 2d., of Bureau of Standards Circular No. 93, entitled "United States Government Specification for Iron-Oxide and Iron-Hydroxide Paints."

This new edition supersedes Bureau of Standards Circular No. 93, 1st edition, entitled "Recommended Specification for Iron-Oxide and Iron-Hydroxide Paints."

The specification as given in the revised edition just issued was adopted by the Federal Specifications Board as Standard Specification No. 13.

Circular No. 82, entitled "United States Government Specification for Linseed Oil, Raw, Refined, and Boiled."

This new edition supersedes Bureau of Standards Circular No. 82, 1st edition, entitled "Recommended Specification for Linseed Oil, Raw, Refined, and Boiled."

The specification as given in the revised edition just issued was adopted by the Federal Specifications Board as Standard Specification No. 4.

Circular No. 91, entitled "United States Government Specification for Ocher, Dry and Paste."

This new edition supersedes Bureau of Standards Circular No. 91, 1st edition, entitled "Recommended Specification for Ocher, Dry and Paste."

The specification as given in the revised edition just issued was adopted by the Federal Specifications Board as Standard Specification No. 12.

Circular No. 111, entitled "United States Government Specification for Flat Interior Lithopone Paint, White and Light Tints."

This new edition supersedes Bureau of Standards Circular No. 111, 1st edition, entitled "Recommended Specification for Flat Interior Lithopone Paint, White and Light Tints."

The specification as given in the revised edition just issued was adopted by the Federal Specifications Board as Standard Specification No. 21.

A limited number of copies for free distribution are available. Single copies will be furnished on request to those concerned. At any time, however, copies can be purchased singly or in quantity at five cents each by addressing request and remittance direct to the "Superintendent of Documents, Government Printing Office, Washington, D.C."

We have much pleasure in publishing the appeal on behalf of Russian Men of Science that appears in this issue.

The President and officers of the Chemical Society have spared no pains to ensure the success of this very humane effort. The sum so far collected is not great, but together with gifts in kind in the way of clothing, books, etc., appear to have been very greatly appreciated.

We would like to suggest that the students at many of our technical colleges and institutions could help by making simple chemical and physical apparatus that would be useful to their hard-pressed comrades in Russia.

The writer has seen instances where classes of students were engaged under the direction of an instructor in fabricating apparatus in glass, wood, etc., that was afterwards either destroyed or lost.

If the heads of departments in technical colleges would take the matter up, much good work might be done. There is very little doubt of the hearty co-operation of the students.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, THURSDAY,
OCTOBER 5TH, 1922, AT 8 P.M.

The following papers were read:—

Cupric tetrammine nitrate and the corrosion of copper by aqueous solutions of ammonia and of ammonium nitrate.—H. BASSETT and R. G. DURRANT.

The additive formation of four membered rings. Part I.: The synthesis and resolution of some derivatives of tetrahydro-1:3-diazine.—C. K. INGOLD and H. A. PIGGOTT.

"THE GENERATION AND UTILISATION OF COLD."

The Faraday Society and the British Cold Storage and Ice Association will hold a joint meeting on Monday, October 16th next, to discuss the present position of the above subject.

The meeting will be held at the Institution of Electrical Engineers, and it will be divided into three sessions, from 2.30 to 4, 4.45 to 6, and 7.45 to 10 p.m. At the first session, following a general introduction by Prof. Alfred W. Porter, F.R.S., President of the Faraday Society, the subject to be discussed will be Laboratory Methods of Liquefaction and Methods of Measuring Low Temperatures.

The opening address will be delivered by Prof. H. Kamerlingh Onnes, and Dr. Crommelin will give a description of the equipment of the Cryogenic Laboratory at Leyden. Subsequent contributors will include Prof. C. F. Jenkin and Dr. Ezer Griffiths.

The second and third sessions will be devoted to Industrial Methods of Liquefaction and Practical Applications of Low Temperatures. The general introduction to this subject will be given by Mr. K. S. (Limited), and among those who will contribute papers will be Monsieur Claude, on the Industrial Manufacture of Hydrogen by the Partial Liquefaction of Water Gas; Mr. E. A. Griffiths, who will deal with the

Murray, of the British Oxygen Company subject as it touches aeronautical work. Messrs. Liquid Air (Limited) will arrange some demonstrations during the intervals, and will also contribute information on the Heylandt System of air liquefaction and on the use of liquid oxygen in blasting.

Invitations to attend the meeting have been extended to members of the London Section of the Society of Chemical Industry and to the Physical Society of London. Others desirous of attending are invited to communicate with the Secretary of the Faraday Society, 10, Essex Street, London, W.C.2.

NOTICES OF BOOKS.

Tested Methods of Non-Ferrous Metallurgical Analysis, by SEYMOUR PILE, M.A. (CANTAB.), and REGINALD JOHNSTON. Pp. 128. London: H. F. and G. Witherby, 326, High Holborn, W.C. 1st 22. Price 7s. 6d. net.

In his prefatory note to this essentially practical volume, Mr. C. T. Heycock mentions that a small amount of impurity may frequently completely alter the physical properties of a metal. Hence the importance of the careful analysis of alloys, which is often a matter of difficulty, and which demands the greatest skill of an inorganic chemist.

The authors concisely describe, sometimes in the technical slang of the laboratory, the methods which their wide experience with the Midland Laboratory Guild has found the most suitable ones for the estimation of the various metals, etc.

The present writer observes that in the case of tin they advocate the use of volumetric methods, in the presence of hydrochloric acid, for the estimation of this metal. (Compare *The Chemical News*, 1920, CXXI., 173).

The book should prove of service to analysts and works' chemists, and perhaps especially to those who are called upon to carry out certain estimations which they may not have performed for some years, in which case the authors' guidance will be of considerable value. J.G.F.D.



This list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 24240—Beach, A. G.—Calculating device for chemists. Sept. 7.
- 24362—Germot, A.—Process for direct obtainment of metallic antimony. Sept. 8.
- 24410—Farlenfabriker vorn.—Process of absorbing ethylene and its homologues. Sept. 8.
- 24059—Leggo, A. B.—Furnace for ore, etc., roasting. Sept. 5.
- 24315—Price, J. W. D.—Chemical compound. Sept. 8.
- 24002—Thompson, W. P.—Manufacture of sulphide dye-stuffs, and processes of dyeing therewith.

Specifications Published this Week.

- 184825—Young, G.—Process for the production of ethers of carbohydrates.
- 184843—Skolev, J. M.—Manufacture of ferro-tungsten and ferro-molybdenum.
- 184912—Turner, W. L.—Manufacture of production of carbon-free ferro-molybdenum.
- 184938—Wilderman, M.—Operation of processes and cells for electrolytic decomposition of alkali salts.
- 184948—Carteret, G.—Process of treating titanium ores containing ore.
- 184957—Usines Metallurgical De La.—Process for the production of basic steel.

Abstract Published this Week.

Ferric oxide; Hydrochloric Acid.—Patent No. 183323.—A process for obtaining Red iron oxide suitable for use as a pigment, has been devised by Mr. D. Tyrer, of Stonleigh, West Villas, Stockton-on-Tees.

It is obtained by heating ferrous chloride in a current of air and steam. The ferrous chloride, preferably in granular form obtained by evaporating pickle liquor while stirring, is spread on the floor of a muffle furnace and air moistened by passing through water at 60° C. is heated to 250–300° C. and passed over it. The exit gas is cooled to obtain hydrochloric acid, and the rate at which the current is passed should be such that the acid condensed contains not more than 30 grams HCl per 100 cc. The gases leaving the condenser are passed to a scrubber fed with water or pickle liquor. Iron compounds decomposable under the conditions of the process, such as hydrated ferric oxide or ferrous carbonate, which may be in the natural condition, may be mixed in finely divided form with the ferrous chloride, and in that case the temperature may be carried higher, for instance to 350° C. There may also be added to the ferrous chloride small quantities of salts having a catalytic effect, namely, salts of copper, magnesium, tin, sodium, and potassium. The addition of a copper salt is stated to improve the red colour of the product.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3261

THE FARADAY SOCIETY.

ANNUAL GENERAL MEETING, NOVEMBER
20TH, 1922.

The following nominations for Officers and members of Council have been made by the Council:—

President: Sir Robert Robertson, K.B.E., F.R.S.

Vice-Presidents: Professor C. H. Desch, Professor F. G. Donnan, F.R.S., Dr. J. A. Harker, F.R.S., Professor T. M. Lowry, F.R.S., W. Murray Morrison, Professor J. R. Partington, Dr. G. Senter.

Treasurer: Robert L. Mond.

Council: W. R. Bousfield, K.C., F.R.S., Cosmo Johns, Dr. R. Lessing, Professor W. C. McLewis, Professor J. W. McBain, Dr. H. Moore, C. C. Paterson, Dr. N. Pring, Professor A. O. Rankine, Dr. E. K. Rideal.

Secretary and Editor: F. S. Spiers, O.B.E.

‘THE GENERATION AND UTILISATION OF COLD.’

A general discussion will be held on the above subject by the Faraday Society and the British Cold Storage and Ice Association on Monday, October 16th, 1922, at the Institution of Electrical Engineers, Victoria Embankment, W.C.2.

Programme.

Session I.—2.30-4.15 p.m.

Chairman: Professor Alfred W. Porter, D.Sc., F.R.S., President of the Faraday Society.

(1) *Introductory Remarks,* by the CHAIRMAN.

(2) *Laboratory Methods of Liquefaction and the Measurement of Low Temperatures in Connection Therewith.*

i. Opening address, by PROFESSOR H. KAMERLINGH ONNES.

(In the unavoidable absence of Professor Kamerlingh Onnes, owing to the sudden death of his colleague, Professor J. P. Kuenen, his address will be communicated by Dr. Crommelin.)

ii. *Description of the equipment of the Cryogenic Laboratories at Leyden,* by DR. CROMMELIN.

iii. *Investigations on ethyl and methyl chloride,* PROF. C. F. JENKIN.

iv. *Practical Methods of calibrating Low Temperature Thermometers,* DR. EZER GRIFFITHS.

v. *Practical Methods of Measuring Low Temperatures,* MR. C. R. DARLING.

Interval for Tea.

Demonstrations by Messrs. Liquid Air (Limited).

Session II.—4.45-6.15 p.m.

Chairman: Mr. George Goodsir, President of the British Cold Storage and Ice Association.

(3) *Industrial Methods of Liquefaction and Practical Applications of Low Temperatures.*

i. Opening address, by MR. K. S. MURRAY.

ii. *Applications in Aeronautical work,* DR. EDGAR A. GRIFFITHS.

Discussion.

Interval for Dinner.

(See separate notice.)

Demonstrations by Messrs. Liquid Air (Limited).

Session III.—7.45-10.0 p.m.

Chairman: Mr. James Swinburne, F.R.S., Past President of the Faraday Society.

Consideration of above subject continued.

iii. *The Industrial Manufacture of Hydrogen by the Partial Liquefaction of Water Gas,* MONSIEUR G. CLAUDE.

Discussion.

THE ABSORPTION OF LIGHT BY SULPHUR AT VARIOUS TEMPERATURES

By MITSUHAU FUKUDA.

It is well known that sulphur changes its colour when heated. This is due to a shift of the absorption band. Generally, the absorption band of a substance moves toward the less refrangible side as its temperature rises. The writer made an experiment to study how the absorption band of sulphur shifts with the variation of the temperature, and the result obtained is given below.

A thin layer of sulphur whose absorption was to be studied was prepared in the following way: a small quantity of the substance was put between two glass plates, and this was slowly heated by a Bunsen-

burner until the hole was uniformly melted.

One junction of a thermo-couple consisting of platinum and tungsten was then inserted into the melted sulphur, and the whole was uniformly heated in an air-bath, the temperature of the other junction being kept constant by means of running water. The above thermo-couple consisted of fine wires of platinum (0.02 mm. dia.) and tungsten (0.035 mm. dia.), they being joined together in a flame of a carbon arc. The couple thus made was previously calibrated up to 300° C. in vacuum oil, the temperature of which being determined by a mercury thermometer.

Next, the absorption spectra of the sulphur at various temperatures were examined with a spectrograph having a replica grating. As the source of light, a carbon arc fed with a salt of calcium was used, and wave lengths of an edge of the absorption bands at various temperatures were determined from the reference lines of calcium. The wave lengths of the edge of the absorption bands determined from these photographic plates did not differ more than 3 μ . The wave lengths of one edge of the absorption band at various temperatures are given in the following table.

Temperature of the Sulphur.	Absorption.
0° C.	From ultra-violet to λ 0.408 μ
20° ..	.. λ 0.410 ..
60° ..	.. λ 0.420 ..
115° ..	.. λ 0.430 ..
120° ..	.. λ 0.435 ..
160° ..	.. λ 0.446 ..
180° ..	.. λ 0.450 ..
200° ..	.. λ 0.458 ..
210° ..	.. λ 0.460 ..
250° ..	.. λ 0.473 ..
300° ..	From ultra-violet to λ 0.488 μ (Thickness of sulphur: 0.3 mm.)

Thus, the less refrangible edge of the absorption band of sulphur proceeds toward the red as its temperature was raised, and within the range of the experiment, the rise of the temperature by 10° C. produces a shift of about 2 μ .

According to the investigation of Kellas,¹ the molecular complexity of the liquid sulphur between 115° C. and 160° C. was represented by S_n , while polymerization from S_6 to S_{18} occurs at a temperature of about 160° C., the latter remaining stable up to the temperature of the boiling point of the sulphur. Now, if the molecular complexities S_6 and S_{18} would absorb different parts of the spectrum, the absorption band of the sulphur should change suddenly in the neighbourhood of 160° C., so that an abrupt bending or discontinuity might be expected in the above line. In the experiment described above, many photographs were taken especially in the neighbourhood of this temperature. No trace of any bending or discontinuity was, however, observed, the edge of the absorption band extending gradually toward the red with the rise of temperature.

Now, if the straight line in the above figure is produced toward the negative side of the temperature axis, it will pass the point ($\lambda=0.390 \mu$, $T=-50^\circ$ C.). Since $\lambda 0.397 \mu$ is the violet end of the visible spectrum, the above indicates that the sulphur will transmit all the visible part of the spectrum when cooled down below -50° C. This confirms the observation of the previous investigators.

Next, the absorption of light by sulphur in a plastic state was studied.

Temp. of Sulphur		Edge of Absorption Band		
before cooling.	after cooling.	before cooling.	after cooling.	untreated one corresp. to temps. given in the second column.
300°C.	100°C.	0.488 μ	0.453 μ	0.418 μ
..	50°C.	..	0.441 ..	0.418 ..
..	20°C.	..	0.435 ..	0.410 ..
..	10°C.	..	—	9.405 ..
200°C.	100°C.	0.458 ..	8.440 ..	0.428 ..
..	50°C.	..	0.434 ..	0.418 ..
..	20°C.	..	—	0.410 ..
..	10°C.	..	0.430 ..	0.405 ..

The sulphur was first heated to a high temperature, and this was then suddenly put into water at various temperatures. The plastic sulphur thus prepared was squeezed between a pair of glass plates, and this was examined in the way described above. The result is given in the above table.

From this, we see that the absorption of light by the plastic sulphur is not simply determined by its present temperature, but it also depends upon the initial temperature to which the sulphur was previously heated. The higher the initial temperature, the longer is the wave length of the edge of the absorption band.

Now, sulphur has two modifications S_8 and S_{18} , and if the sulphur at 300°C . was gradually cooled down to 100°C . for example, S_{18} would completely transform into S_8 , but if it was rapidly cooled, this is not the case, because its absorption spectrum corresponds to that of a higher temperature of about 180°C . Thus, the plastic sulphur will consist of S_8 and S_{18} mixed in a complex way.

In conclusion, the writer wishes to express his thanks to Prof. M. Kimura for his kind guidance.

(From "Memoirs of the College of Science," Kyoto Imperial University.)

[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF ILLINOIS.]
OBSERVATIONS ON THE RARE EARTHS. XII. THE ATOMIC WEIGHT OF LANTHANUM.

By B. S. HOPKINS AND F. H. DRIGGS.

During the progress of the work upon the rare-earth group, there was received at this laboratory a shipment of 182 kg. of sodium rare earth sulphates, which was generously supplied by the Welsbach Company, of Gloucester, New Jersey, and its chief chemist, Dr. H. S. Miner. The early treatment of this material¹ consisted in the removal of cerium by the method proposed by James and Pratt, and fractional crystallisation as the double magnesium nitrate. This work was done by Dr. Edward Wichers. Later the fractions from the insoluble end of the series which contained

¹ See Hopkins and Kremers, *Bur. Standards Sci. Papers*, 421, Part II. (1921).

² James and Pratt, *Jour. Amer. Chem. Soc.*, 33, 1326 (1911).

lanthanum and praseodymium were subjected to a long series of fractional crystallisations as the ammonium-rare earth nitrates the care of Dr. E. W. Engle. The fractionation was continued until the first 20 fractions failed to show the slightest trace of praseodymium in their absorption spectra, when viewed through a 10 cm. layer of concentrated solution.

PURIFICATION OF MATERIAL.

Portions of Fractions 7 and 8 of the double ammonium nitrate series were diluted and treated with a hot dil. solution of oxalic acid. The precipitate was washed, dried and ignited to the oxide in an electric muffle. The oxide was redissolved in nitric acid, diluted to 2,000 cc. and lanthanum hydroxide precipitated by distilling ammonia vapours into the solution. This precipitate was washed thrice by decantation and redissolved in nitric acid. The alternate precipitation of hydroxide and oxalate was repeated four times, the last two precipitations being carried out in conductivity water. The ignited oxide was then suspended in conductivity water and dissolved by passing over it the vapour obtained by distillation of c. p. hydrochloric acid from a quartz flask.

A portion of Fraction 8 of this series was sent to the Bureau of Standards, where it was examined spectroscopically by the use of 4 gratings, 1 of 7,500 lines per inch for the infra-red region, 1 of 10,000 lines per inch and 2 of 20,000 lines per inch for other portions of the spectrum. Photographs were made in the region between 5500 Å. and 9000 Å., and these "have been compared with similar results derived by Eder from Auer von Welsbach's preparation." The material was found to be "of a high degree of purity, no lines being found thus far which can be attributed to any of the related elements."³

All the reagents used in this investigation were carefully purified by the identical methods that have been used and described in earlier publications from this laboratory.⁴

PREPARATION OF ANHYDROUS LANTHANUM CHLORIDE.

Two methods were used in the preparation of the anhydrous chloride. The first consisted in placing a portion of the chlor-

³ "Report on Progress of the Study of the Spectra of the Rare Earth Elements," Bureau of Standards, Sept., 1920.

⁴ Kremers, Hopkins, and Engle, *Jour. Amer. Chem. Soc.*, 40, 601 (1918).

ide solution in a quartz reaction flask and drying in a current of air and hydrogen chloride until the salt began to crystallise. The air was then stopped and only hydrogen chloride was passed through. The temperature was maintained below 85° by means of an electric oven until the first 5 molecules of water had been driven off. The temperature was then gradually raised to 125° when the last molecule began to come off. As soon as this evolution was complete the temperature was raised to 325° and kept at this point for 1 hour, after which the salt was rapidly fused in the Bunsen flame.

Due to the slow removal of water from the chloride solution by this method, the last 5 determinations were made by first evaporating the lanthanum chloride solution to a small volume and separating the salt by saturating the solution with hydrogen chloride. The hydrated salt was filtered, dried and crushed in an agate mortar and kept in a desiccator over fused potassium hydroxide. A portion of this was introduced into the reaction flask for each determination and the dehydration carried out as described in the preceding paragraph. This method enabled us to prepare the anhydrous chloride much more quickly and satisfactorily than when the chloride solution was introduced into the reaction flask.

DETERMINATION OF ATOMIC WEIGHT.

After fusion of the anhydrous salt in the

reaction flask the hydrogen chloride was displaced by passing air through the apparatus until the escaping air gave no test for chloride when bubbled through a silver nitrate solution. The caps on the outlet and inlet tubes were then adjusted, and the flask was hung in the balance case for several hours and weighed.

The fused lanthanum chloride was then dissolved in conductivity water, transferred to an Erlenmeyer flask and diluted to about 1,000 cc. Silver was etched and weighed to within 1 mg. of the calculated amount, dissolved in redistilled nitric acid and diluted to about the same volume. The silver solution was then added to the chloride solution with constant shaking and placed in a shaking machine overnight. The clear solution was tested in a nephelometer for excess of silver or chloride, and the calculated deficiency was added from a standard solution of silver nitrate or sodium chloride until the nephelometer indicated equivalence.

The weighings were made by the method of substitution, the tare flask used being of quartz and differing in weight from the reaction flask by only a few milligrams. The weights were standardised to 0.01 mg., and weighings were corrected to the vacuum standard.

The following densities were used: lanthanum trichloride, 3.947;⁵ silver, 10.5; weights, 8.4. The atomic weight of silver was taken as 107.88, and that of chlorine as 35.457.

TABLE I.

No.	Wt. of LaCl ₃ Gram.	Wt. of Ag. Gram.	Ratio	At. Wt. of La.
1	0.60680	0.80078	0.75776	138.87
2	0.73504	0.96987	0.75787	138.91
3	1.02450	1.35189	0.75783	138.89
4	0.92965	1.22654	0.75794	138.93
5	1.84436	2.43317	0.75807	138.97
6	0.72863	0.96164	0.75769	138.85
7	0.52934	0.78180	0.75766	138.84
8	0.98017	1.29330	0.75788	138.91
9	1.02852	1.35729	0.75778	138.88
10	0.85193	1.12428	0.75775	138.87

Av. At. Wt. 138.89

SUMMARY.

On the basis of 10 determinations of the atomic weight of lanthanum by the precipitations of the chloride, the average value of 138.89 was obtained, in excellent agreement with the value 138.91 found by Baxter, Tani and Chapin.⁶ The close agree-

ment of these two results indicates that the value selected by the International Committee, 139.0, is slightly too high.

URBANA, ILLINOIS.

(From "Memoirs of the College of Science," Kyoto Imperial University.)

⁵ *Compt. rend.*, 140, 1339 (1905).

⁶ *Baxter, Tani and Chapin, Jour. Amer. Chem. Soc.*, 43, 1080 (1921).

ON THE COLOUR OF COLOURED FLUORITES.

BY TOKUTARO SAKAO AND MITSUIE HIROSE.

The cause of the colours of Blue John and other varieties of fluorite has long been a matter of doubt and controversy. Messrs. Blount and Sequeira carried out an interesting investigation on the problem, and the result was briefly described in the Transactions of the Chemical Society.

According to their conclusion there is no substantial difference between a white fluorite and blue, green and amethystine varieties, except the presence of a small amount of organic matter, and the colours are ascribed to this organic matter. But the state of dispersion of the latter is not discussed.

Now it is already ascertained that the blue colour of certain varieties of rock salt is due to a colloidal dispersion of sodium in sodium chloride, and that the blue colours of sodalite and ultramarine are almost certainly due to a similar cause. As was suggested in *Nature*,² though the colour of the fluorites is ascribed to the presence of some organic matter, yet the problem is not completely solved. The present writers, under the suggestion of Prof. M. Kimura, attempted an experiment to examine by means of an ultra-microscope the state of the suspected organic matter in the crystal, and a short account of the result obtained will be given below.

In the present experiment the following specimens were selected and examined.

(1) A piece of a transparent crystal, one half of which was coloured amethystine, while the remaining part exhibits a green colour.

(2) A piece of a green fluorite having a transparent stria.

(3) A piece of perfectly transparent fluorite.

(4) two pieces of green fluorite, one of which is more deeply coloured than the other.

(5) A colourless crystal obtained by baking a piece of a green variety.

Small pieces of the crystal mentioned above were selected from several pieces of the crystal; and they were cut into parallel plates having a thickness about 1 mm., and then the surfaces were polished with emery and then rouge, to secure an optical surface. The plates prepared were exam-

ined with an ultra-microscope having a cardioid condenser, illuminated by the light from a 20-ampere carbon arc.

In all the coloured specimens mentioned above a uniform distribution of an immense number of particles as is usually seen in the case of coloured glasses and of colloidal solutions could not be detected at all, the only thing observed being a very few bright particles. These particles were distributed very irregularly and their number varied from plane to plane within the crystal, the total number seen in a field of view being not greater than about ten.

In a transparent portion of the crystal such particles were also observed, and their number and mode of distribution did not present a sensible difference even in crossing at the boundaries of a transparent stria in the green fluorite. Moreover, in certain specimens it was ascertained that a weakly coloured crystal contains a larger number of the bright particles than a highly coloured one.

These facts seem to indicate that the particles under consideration have no relation with the cause of the colour of the fluorite. As to the nature of these particles no definite conclusion can be drawn from the present experiment, but we may consider that the particles might be minute holes or some impurities contained within the crystal.

If the particles were totally taken out of consideration the coloured fluorite is optically clear. This means that if the organic matter found by Blount and Sequeira be in a state of colloidal suspension, it should have the same index of refraction as that of the fluorite, or that the colloidal particles should be too fine to be detected in the present experiment. Otherwise, the organic matter would be scattered into the molecular state in the crystal.

(From "Memoirs of the College of Science," Kyoto Imperial University.)

BRITISH ASSOCIATION.

FUEL ECONOMY

V. DOMESTIC HEATING AND COOKING APPLIANCES.

(Continued from Page 197.)

A good deal of valuable investigation work has recently been done by persons not actually engaged in the industries concerned in the direction of testing the efficiencies of domestic heating and cooking appliances, with results of considerable interest in connection with the important

1. Vol. 115, 705 (1919).

2. *Nature*, Sept. 13, 1919.

question of fuel economy in our homes, where are burnt not only some 40 million tons of coal per annum, but also the bulk of the gas and some of the coke sent out from the country's gasworks.

In the first place, physiological research has emphasised the intimate connection, from the point of view of health and comfort, between the cognate problems of heating and ventilation in regard to domestic apartments. Moreover, the introduction of the Kata-thermometer has placed at our disposal a new method for estimating the "cooling power" of the air, which has been shown to be a governing factor in regard to what may be termed "comfort conditions" in living rooms. Also, the physiological value of radiation from a red-hot incandescent surface, as distinct from convected heat, has become to be more clearly recognised than ever before. Indeed it may be said that the more nearly the conditions under which our living rooms are warmed and ventilated approach those of a warm summer's day—a cooling breeze blowing round the head, the varying sunshine warming one side of the body, and the warm ground for the feet—the more comfortable and healthful will they be. The desirability of such conditions, which may be contrasted with the warm air of rooms heated by convection from steam coils, probably explains the Englishman's decided preference for the radiation from an open fireplace during our dreary British winters over the various forms of central heating which are favoured in America and other countries where the winters are colder but brighter. Therefore, having regard to the character of British winters, the estimation of the "radiant efficiencies" of domestic fires is of predominant importance.

The "radiant efficiency" of a modern gas fire may be said to be about 50 per cent. on the *net* calorific value of the gas burnt therein; moreover, experiments made under Professor W. A. Bone's direction at South Kensington have proved that, within wide limits, such radiant efficiency is independent of the chemical composition and calorific value of the gas burnt, provided that the number of calories by combustion developed per hour is kept suitably constant for the particular size of fire. Gas fires are now available which are capable of ventilating rooms quite as well as an open coal fire; and it may be taken for granted that both these appliances are capable of providing a healthful source of radiation for the warming of living rooms without un-

duly heating the atmosphere thereof. With regard to electric radiators, whose radiant efficiency may be as high as 75 per cent., while these are very portable and therefore convenient for placing where the heat is required, they do not directly ventilate an apartment.

The recent determination by Dr. Margaret Fishenden, for the Manchester Corporation Air Pollution Advisory Board, of the radiant efficiencies of coal, coke, and semi-coke when burnt in open fire-places (Fuel Research Board Special Report, No. 3) are of considerable interest. Her experiments have shown, not only that such efficiency is much greater than has generally been supposed, but also that there is not so much difference as might be thought between the efficiencies of different grades.

Working with a number of coal-fired open grates, including what were supposed to be the best and the worst types, the radiant efficiency in all cases was found to lie between 20 and 24 per cent. of the heat of combustion of the coal actually burnt during each test. When *dried* coke was used as fuel, radiant efficiencies up to 25 and even 28 per cent. were obtained; the values were, however, materially diminished when wet coke was used. Tests made with the low-temperature carbonisation "semi-coke" gave radiant efficiencies of up to 33 per cent. in a grate which with ordinary coal gave 25 per cent. It is also to be noted that the tests showed that, within the limits likely to be encountered in practice, with domestic fire-grates the radiant efficiency was found to be independent of the draught intensity, and also confirmed previous experience that treatment of the fuel with preparations (consisting mostly of common salt), which are sometimes advertised as doubling the value of a ton of coal, had no appreciable effect upon its radiant efficiency. Altogether, then, Dr. Fishenden's investigations may be said to have gone far to remove from the open fire-place the stigma of gross inefficiency.

The Fuel Research Board have also published some work by Dr. Fishenden which deals with the efficiency of kitchen appliances (Fuel Research Board Technical Paper No. 3: "The Efficiency of Low-temperature Coke in Domestic Appliances"), and, in addition, one of the members of our Committee (Mr. A. H. Barker) has also devoted considerable time to the difficult question of the determination of the efficiency of domestic cooking appliances. A memorandum by him on

the subject is appended to this Report, the results of his experiments having been published in detail by the Fuel Research Board (Special Report No. 4).

Dr. Fishenden has concerned herself with the determination of the radiant efficiencies of the ranges examined, as well as their efficiency in the production of hot water, whereas Mr. Barker has concerned himself generally with the question of the efficiency of ranges when functioning for the production of hot water or for cooking. The latter Report also touches upon the question of gas and electric cookers, but the Committee does not propose to comment upon this aspect of the case, as it would appear to require further investigation.

Whilst perhaps it would be premature to express any final opinion as to the precise significance of the results obtained, in view of the fact that the work is from the experimental point of view in its infancy, and that rather marked differences in efficiencies are cited in the two Reports, due probably to differences in the type of range tested, the Committee desires to call attention to the very great interest of the work at the present juncture, and to the desirability of the inquiry being continued.

The combination of several different functions, namely, of a fire-heated oven, a fire-heated hotplate, a fire-heated boiler, and also a fire to warm the kitchen, would appear to involve heavy fuel consumption, as compared with the fuel required for appliances designed to perform these functions separately. Thus, for example, Dr. Fishenden obtained a water-heating efficiency of 17 per cent. from an old-fashioned open kitchen range, whilst a later type of independent boiler—which also functioned as an open fire—gave an efficiency of 35 per cent. for water heating, and, in addition, an open fire radiation of 7 or 8 per cent. Moreover, Mr. Barker's tests yielded hot-water efficiencies varying from 7 to 17 per cent. in kitchen ranges, as against efficiencies of 40 to 50 per cent. obtainable with separate hot-water supply apparatus.

Mr. Barker's work indicates also that the existing designs sacrifice fuel economy to convenience in providing an exposed hotplate adjacent to the oven, and that the fuel consumption for oven cooking may be reduced by lagging the hotplate. It is difficult to assess the value of the house heating done by the present-day kitchen range, but any detailed review of the sub-

ject should make some endeavour to assess its value.

In the Committee's Report in 1916 it was stated that "the whole question of the domestic use of fuel bristles with difficulties and complications . . . the solution or recommendation of particular means or apparatus for domestic heating cannot always be based simply upon the question of thermal efficiency, because it also involves considerations of a physiological and even of a psychological character. In the vast majority of houses inhabited by the artisan population, the kitchen fire or stove is the only place in the house where fuel is burned." In addition, it might be added that in the latter type of house prime cost often becomes the determining factor, and sacrifices of efficiency have to be made to ensure a small capital outlay.

The Reports under review appear to the Committee to justify a reconsideration of the factors underlying the design of solid fuel types of domestic appliances with a view to determining whether improvement in fuel economy can be obtained without either an unreasonable sacrifice of convenience or an excessive addition to the cost of production. In very many cases the actual dweller has had no say in the selection of the kitchen range, nor has he the means or the facilities for replacing such as may have been provided for him.

With regard to the existing types of combined range, it is felt that attention should be called to one point in Mr. Barker's Report, namely, that the CO_2 content of the flue gases did not exceed 5.5 per cent. in the best ranges tested, and that in several cases it was much below this, suggesting that in some cases sufficient attention has not been paid to the regulation of the air supply.

The Committee would suggest the following three points for more general consideration: (1) The general adoption of means to reduce the excess of air drawn through the system by so enclosing the fire that air does not get to the combustion chamber otherwise than through the fire grate, although retaining a feature which characterises existing appliances in providing means to enable an open fire to be obtained for kitchen heating when the other functions of the range are not required; (2) the use of effective lagging of oven doors which is not generally adopted at present; (3) the desirability of removing the ordinary hot-water boiler from the range and the sub-

stitution thereof of an independent boiler, separately fired: at present it would appear that such combinations are only provided in a limited number of middle-class houses, or in the case of very large ranges.

VI.—STEAM RAISING AND POWER PRODUCTION.

The Committee desires to call attention to the great need there is for some more systematic effort on the part of steam users to improve the present admittedly unsatisfactory state of boiler practice throughout the country, especially in the direction of educational provision for the better training of stokers and power-station superintendents. Notwithstanding the greater attention which is nowadays paid to the subject of "efficiency" in some of the larger steam-raising installations and power-stations, there still exists in far too many cases a lamentable disregard for the elementary principles of good boiler management. Indeed, it may be doubted whether, taking the country as a whole, the average efficiency of steam-raising exceeds 60 per cent. on the calorific value of the coal burnt, whereas if scientific operations replaced rule-of-thumb working it might be raised to 75 per cent., with consequent great saving in fuel.

The most frequent and serious cause of avoidable heat-wastage in current boiler practice arises from the fact that unnecessarily large excesses of air are usually drawn through the system owing to sheer neglect of some of the most obvious precautions. With good management it should be possible, by careful damper regulation and maintaining a correct depth of fire, to burn completely an average quality of steam coal with no greater excess of air than would give about 12 per cent. of CO_2 (without appreciable quantities of CO) in the chimney gases; but far too frequently as much as twice such minimum excess of air is drawn through the system. It is not sufficiently realised how highly important to fuel economy are the proper regulation of the draught by dampers, the correct proportioning of grate area to the quantity and size of the coal burnt, and the avoidance of leakage of cool air into the boiler setting by keeping the brickwork in good repair and well pointed, and efficiently caulking the joint between the brickwork and boiler shell. Proper attention to such elementary points would reduce the "sensible heat" lost in the chimney gases to 18 per cent. of the total calorific power of the

coal burnt, whereas neglect of them often means twice such loss.

Whilst the more general use of indicating and recording apparatus may be recommended as the best automatic aids to good management, yet unless these are supplemented by intelligence and watchfulness on the part of both stokers and boiler-house superintendents, they will not avail much or may be actually misleading. The Committee, therefore, desires to impress upon both manufacturers and the public education authorities the need there is not only of better boiler-house supervision, but also of the better instruction and training of the boiler-house personnel. It cannot be urged too often upon steam users that considerable economies can be effected with existing plant and appliances, provided that they are run under the skilled supervision of properly trained men. In the case of large boiler installations it will usually pay to put them under the control of a well-trained fuel technologist, and there are several institutions in the country where such men are being scientifically as well as practically trained. Local education authorities could effectively help fuel economy by instituting in the various technical schools throughout the country properly organised classes for the instruction of stokers and the lower grades of boiler-house attendants. In addition to such classes, the institution in some of the larger centres of more advanced and specialised lectures, with opportunities for discussion, upon combustion, heat transmission, and boiler management generally for boiler superintendents and engineers, would undoubtedly be of great advantage.

In connection with the production of electric power by Public Utility Undertakings, the Committee would point out that the Electricity Commissioners could render a great national service if, in their annual returns, they would publish such financial and detailed technical data as are necessary to show the actual fuel consumptions and total cost of production per unit of output in the various individual power stations throughout the country. The present annual returns are not sufficiently detailed for this purpose, and in particular do not show the circumstances (such as load factor) under which the current is produced. It would undoubtedly stimulate healthy competition, promote fuel economy, and reduce costs, if the individual power stations were required to furnish for publication all the necessary technical data to enable fair comparisons to be made.

VII. SMOKE ABATEMENT.

During the past year the Departmental Committee appointed by the Ministry of Health "to consider the present state of the law with regard to the pollution of the air by smoke and other noxious vapours, and its administration, and to advise what steps are necessary and practicable with a view to diminishing the evils still arising from such pollution," has issued its final Report. After full consideration of the matter, it was not thought practicable at present to propose legislation dealing with smoke from private dwelling houses, although it was estimated that as much as 2½ million tons of potential fuel in the form of soot escape annually into the atmosphere from domestic fire-places, as against only 500,000 tons from factory chimneys, which latter seems a very low figure. It was, however, recommended that the Central Housing Authority should have certain supervisory powers in regard to heating methods over housing schemes submitted by local authorities, and that the latter be empowered to make by-laws requiring the provision of smokeless heating arrangements in new buildings other than private dwelling houses. This is probably as far as it is practicable to go in the present state of public opinion; for it seems wiser to rely upon its further education and enlightenment rather than upon vexatious legislative prohibition for the abatement of domestic smoke.

With regard to the question of industrial smoke, it was recommended by the Departmental Committee: (1) that the Ministry of Health should be given clearly defined power to compel or act in place of any defaulting authority which refuses to perform its duties in administering the law with regard to smoke; (2) that, instead of the present absolute prohibition, which it is impossible to observe, there should be imposed upon all manufacturers, users and occupiers of any business premises or processes, engines or plant of any description whatever, a general legal obligation to use the best practicable means, having regard to all the circumstances of the case, including the question of cost, for avoiding pollution of the air by smoke, grit, or any other noxious emissions; (3) that the same law should also apply to all Government establishments, and all rail and road locomotives and motor cars of whatever weight and type, and to steamers on rivers, estuaries, and lakes; (4) that the Ministry of Health

should be empowered to fix smoke standards from time to time; (5) that the duty of enforcing the law with regard to the pollution of the air by smoke should be transferred from the local sanitary authorities, in whose jurisdiction it now rests, to the county authorities—i.e., the Councils of Counties and County Boroughs; albeit that minor authorities should still have the power to take proceedings, if they so desire; (6) that for proved breaches of the law much larger fines should be imposed than at present; and (7) that the Minister of Health should assign to one or more competent officers the duty of advising and assisting local authorities and manufacturers with regard to difficult smoke problems, and that such officers should report annually in the steps which are being taken, and the progress which has been made, in the suppression of avoidable smoke.

Since its inception in 1915, this Committee of the Association has carefully considered data and proposals relating to the causes and prevention of industrial smoke, and has been pleased to note progressive improvement, due largely to the increasing study of fuel economy in its various branches in regard to smoke abatement throughout the country, and that the Ministry of Health has taken evidence with a view to passing further legislation on more rational lines than that at present existing, which has become very much of a dead letter by reason of the extreme remedies it proposes.

It must be remembered that, even with the best appliances used with the greatest care, it is practically impossible altogether to prevent black smoke being produced for some small portion of the time when raw bituminous coal is burnt, and that in some industrial operations more smoke is apt to be produced than in others. It is evident, therefore, that no legislation should penalise the emission of what may be reasonably considered to be the *minimum* amount of smoke by competent judges who are familiar with the nature and the requirements of the particular industrial operation concerned. Indeed, it may be predicted that any attempt to do so would probably be as ineffective as the present enactments, and would thereby merely defeat its own purpose.

This Committee, having carefully considered the matter in its various aspects, has come to the conclusion that the best

way of further abating the pollution of the atmosphere by smoke would be the institution by the Ministry of Health of a national Smoke Inspectorate on similar lines to the already existing Alkali Inspectorate, which has admittedly worked well and with beneficial results to the industry concerned.

Changes in Membership.—Since its last reappointment the following changes have taken place in the membership of the Committee. Mr. E. Bury retired on account of frequent absence abroad; Sir Joseph Walton, M.P., retired on account of ill-health, and Mr. Robert Armitage, M.P., was co-opted in his place. Mr. Wallace Thorneycroft has been co-opted in the place of the late Mr. G. Blake-Walker, and Mr. E. Myers in the place of Mr. D. V. Hollingworth. Also the following new members have been co-opted during the year: Messrs. J. E. Hackford, H. Stafford Rayner, L. L. Robinson, and W. C. P. Tapper.

The Committee recommends that it be reappointed to continue its investigations, with a grant of £5.

APPENDIX.

Memorandum on Determining the Efficiency of Cooking Appliances

The efficiency of appliances for the utilisation or transformation of heat energy cannot be regarded so definite a function as in the case of mechanical or electrical ones. Since no non-conductor of heat is known, the actual thermal efficiency, however determined, must be variable according to the conditions.

In the case of cooking ranges and appliances, the conditions are so variable and complicated that it is difficult to devise test methods which shall invariably produce approximately the same numerical result from the same appliance on two or more separate occasions. Unless this is done, any figures must necessarily be uncertain, and no reliable comparison can be made between two different appliances in respect of efficiency.

In order that such figures should bear close relation to the efficiency of the appliance as used in practice, it is desirable that the experiments should be made under con-

ditions similar to those in which the appliance is actually used, but unfortunately this is, in the nature of things, impossible. No reliable figures could be obtained while the apparatus was in use in cooking an actual article of food, because the amount of heat transmitted to such material cannot be measured, and also because of the extreme variations which arise in all the observable physical magnitudes during such an operation. Thus it is impossible to say when two similar joints are cooked to the same degree. It is, therefore, essential that the object heated for test purposes should be very different from an article of food, and such that the heat communicated to it should be capable of exact measurement.

(To be Continued.)

BRITISH ASSOCIATION.

SECTION K—BOTANY.

TRANSPORT OF ORGANIC SUBSTANCES IN PLANTS.

ADDRESS BY PROFESSOR H. H. DIXON,
SC.D., F.R.S., PRESIDENT OF THE

SECTION.

(Continued from Page 205.)

As the stimulus travels both in a basipetal and acropetal direction, we may assume that movement of the transpiration-stream in a downward direction is of normal occurrence in plants.

Contemporaneously with, and subsequently to, Ricca's important work on *Mimosa*, experimental evidence has been accumulating to indicate that the transmission of other stimuli—viz., phototropic, traumatotropic, thigmotropic, and geotropic—is effected by means of the passage of a dissolved substance. Boysen-Jensen appears to have been the first to announce that phototropic and geotropic stimuli may be transmitted across protoplasmic discontinuities. Paál emphasised this by showing that these stimuli are able to pass a disc of the tissue of *Arundo donax* impregnated

with gelatine, which is interposed between the receptive and responding regions. These observations rendered the view that the stimulus is transmitted in the form of a hormone extremely probable; and later Stark showed that this hormone is thermostable, just as Ricca had done in the case of the hormone of *Mimosa*. Another very interesting point discovered by Stark—working with traumatic stimuli—is that the hormones are to a certain extent specific. Thus if the perceptive tip of a seedling is removed from one plant and affixed in position on another, the certainty of the response depends on the genetic affinity of the two plants.

In all these cases it seems certain that

Plant.	Nature of Stimulus.	Transmission Time in secs. per mm.
<i>Mimosa</i>	Heat	0.07
<i>Drosera</i>	Chemical	6.00
Seedling	Light	180-300
"	Gravity	300
Tendrils	Contact	17
Diffusion in tissue		2250-3600

There is thus every reason to believe that the transmission of stimuli generally through the tissues of the higher plants is effected by the conveyance of a hormone in the wood of the vascular bundles from the receptive to the motile regions, and whenever this transmission is in a downward direction evidence is afforded of the downward movement of water in the tracheæ. It is reasonable to suppose that this downward current is able to carry organic food-stuffs as well as hormones.

Thus the evidence for the existence of a backward flow of water in the tracheæ of wood, in addition to the more obvious upward stream, is convincing. With regard,

the perceptive tissues are the point of origin, when stimulated, of a dissolved substance, the hormone, which makes its way to the motile tissues and releases the response.

In the case of *Mimosa* just alluded to, and of the labellum of *Masdevallia* examined by Oliver, there is direct evidence that the transmission of the hormone is effected by the vascular bundles. In *Mimosa* the channels are more precisely localised as being the tracheæ of the wood. Furthermore, the rapidity of transmission renders it certain that simple diffusion through the tissues of the plant will not account for the process. Some recorded velocities of transmission are here enumerated for the sake of comparison:—

however, to the mechanism by which the backward stream is supplied we have but scant information.

The volume-changes of leaves which Thoday has recorded are suggestive in this connection. These changes he found of various magnitudes, occurring simultaneously in different or in the same leaves. They may cause a linear contraction amounting to 2.5 per cent. in ten minutes, and may produce a volume contraction of 7 per cent. in the same time. The water corresponding to this volume-change in the cells of the leaf if transmitted into the tracheæ would produce a considerable downward displacement, as may be seen from the following figures:

Name of Plant.	Volume of 1 per cent. contraction in mm.	Cross-section of tracheæ in petiole in mm.	Downward movement in cm.
<i>Acubia japonica</i> ..	22.8	0.05	15.6
<i>Solanum tuberosum</i> ..	28.0	0.07	10.0
<i>Syringa vulgaris</i> ..	12.15	0.013	16.5
<i>Acer macrophyllum</i> ..	12.2	0.22	19.2

If these changes in volume are caused by, or accompanied with, a development of permeability of the contracting cells, evidently a backward movement of organic

substance having a velocity of about 120cm. and more per hour would be produced.

It is possible that the tension which causes these contractions of the leaf cells at the same time acts as a stimulus to in-

crease the permeability of the plasmatic membranes of the cells; and so one might imagine that the development of a certain tension would automatically release organic substances from the cells and draw them through the tracheæ downwards. Direct experiment on this point presents difficulties, but it may be worth recording that when the internal osmotic pressure of the leaf-cells was overbalanced by an external gas-pressure, the water pressed from the cells and forced out of the tracheæ of the supporting stem was found to be practically pure, and if it contained carbohydrates they were in such small quantities that no reduction could be detected with Benedict's solution either before or after inversion. This experiment was repeated several times with branches of *Sambucus nigra* and *Tilia americana*. The cut branch, well supplied with water, was first exposed for several hours to conditions favourable to photosynthesis, and then either immediately or after a sojourn in darkness subjected to the gas-pressure. A pressure of thirteen atmospheres was found sufficient to drive water back from the leaves out of the stem.

Of course the conditions of this experiment are not those obtaining in the normal plant, where during transpiration the volume of a leaf, or part of a leaf, changes. In the transpiring plant we can also imagine the accumulation of a substance or an ion which would give rise to an alteration of the permeability of the plasmatic membranes of the leaves.

When, in order to imitate these conditions, the cells of the leaves in the foregoing experiment are rendered permeable by the introduction of a little toluene into the pressure-chamber, the application of a smaller pressure is sufficient to press the cell-contents into the water-channels and liquid emerges from the base of the stem which readily reduces Benedict's solution.

In the same way, if a pinna of *Sambucus nigra* is surrounded with toluene vapour, transpiration from the adjacent pinna draws back the cell-contents of the toluened pinna, and afterwards their track in the wood of the vascular bundles of the rachis may be traced by the browning of this tissue.

Another possibility presented itself—viz., that the direction of the current might act as a stimulus regulating the permeability of the cells in contact with the tracheæ. To test this, short lengths of stem set in their normal position were supplied, first through

their lower and afterwards through their upper end, with distilled water. In neither case could carbohydrates be detected in the issuing stream.

The foregoing short consideration of some recent physiological work leads us, then, to the following conclusions:

The transport of the organic substances needed in the distal growing regions is effected through the tracheæ of the wood. The substances travel dissolved in the water filling these channels, which is moved by transpiration, expansion of the growing cells, or root pressure.

Physical considerations forbid us admitting that sufficiently rapid transport can be afforded by the bast either for the observed upward or downward distribution of organic substance.

The existence of downward as well as upward movement of water in the tracheæ of the wood may be demonstrated by suitable experimental means, and may be inferred by the transport of hormones in the wood.

The occurrence of local contractions in leaves suggests that local increases of permeability supply dissolved organic substances to the distal ends of certain of the filaments of tracheæ. The tension developed by the transpiration of other regions draws these along downward as well as upward channels in the wood.

In thus ruling out the participation of the bast in the longitudinal transport of organic substances in plants one naturally is forced to speculate on its probable function. Its distribution and conformation are such that, while it possesses a very small cross-section, it appears with the other living elements of the vascular bundles, medullary rays, wood-parenchyma, &c., to present a maximum surface to the tracheæ.

This large surface may find explanation in the necessity of interchange between the living cells and dead conduits. The colloidal contents of the former render this process slow, hence the necessity for the large surface of interchange to enable sufficient quantities of organic substances to be abstracted from and introduced into the tracheæ to meet the needs of the plant.

Before concluding, I would like to add that the experimental work carried out on this matter would have been quite impossible for me were it not for the assistance and ingenuity of Mr. N. G. Ball. He also has contributed materially by his criticisms and suggestions.

[END.]

[CONTRIBUTION FROM THE JOHN HARRISON
LABORATORY OF CHEMISTRY, UNIVERSITY
OF PENNSYLVANIA.]

THE SODIUM TUNGSTATES. I.

BY EDGAR F. SMITH.

Wolcott Gibbs¹ wrote

"The alkaline tungstates are numerous and unusually complex. Salts of essentially different formulas approach so closely in percentage composition, that the differences lie very near the unavoidable errors of analysis. . . . The analyses are hardly sufficiently close to decide the question upon purely analytical grounds."²

This comment was evoked on considering more particularly the various sodium tungstates; for, he added:

"As the general result of my own study of the salts themselves and of the work of Scheibler, Marignac, Lotz, Forcher, Laurent, Lefort, and others . . . I have arrived at a new classification and arrangement: the normal and metatungstic series."³

Gibbs repeatedly obtained a sodium salt, the analysis of which agreed very closely with the formula, $9\text{Na}_2\text{O} \cdot 22\text{WO}_3 \cdot 51\text{H}_2\text{O}$, and thought it might be the representative of a new class or series. A glance at Dammer's Handbuch, picking out the recorded sodium salts, discloses at least eight ratios between basic oxide (Na_2O) and acid oxide (WO_3); and, of the $5\text{Na}_2\text{O} \cdot 12\text{WO}_3 \cdot 28\text{H}_2\text{O}$ salt, containing sometimes less than $28\text{H}_2\text{O}$, depending upon the manner of its crystallisation, he said its constitution, it was believed by some, was best expressed by the formula $3\text{Na}_2\text{O} \cdot 7\text{WO}_3 \cdot 16\text{H}_2\text{O}$.

In the Gibbs arrangement there are only three outstanding members claiming consideration: (a) normal sodium tungstate; (b) sodium paratungstate; and (c) sodium metatungstate. To these, through the

studies of Gibbs, there should be added $4\text{Na}_2\text{O} \cdot 10\text{WO}_3 \cdot 23\text{H}_2\text{O}$ and probably $3\text{Na}_2\text{O} \cdot 22\text{WO}_3 \cdot 51\text{H}_2\text{O}$.

In commencing the present study, the writer desired to prepare a series of derivatives of "complex inorganic acids," starting with ammonium paratungstate but, annoyed by its sparing solubility, he turned to its sodium analog, made by the method of Scheibler.

Dammer⁴ states that this salt, $5\text{Na}_2\text{O} \cdot 12\text{WO}_3 \cdot 28\text{H}_2\text{O}$ —is produced by adding carbon dioxide to the aqueous solution of the normal salt ($\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$), whereas Forcher⁵ got $4\text{Na}_2\text{O} \cdot 10\text{WO}_3 \cdot 23\text{H}_2\text{O}$ by this procedure.⁷ Small, brilliant crystals separated and when they no longer increased appreciably in quantity, were filtered out and washed repeatedly with ice-cold water, until the wash-water did not effervesce on the addition of hydrochloric acid. They were recrystallised.

Forcher was, probably, the first person to observe this salt, to which he ascribed the formula, $2\text{Na}_2\text{O} \cdot 5\text{WO}_3 \cdot 12\text{H}_2\text{O}$. Marignac obtained it, but was ignorant of the fact that Forcher had prepared and analysed it. Marignac gave it the formula, $2\text{Na}_2\text{O} \cdot 5\text{WO}_3 \cdot 11\text{H}_2\text{O}$. The literature contains very little relating to the salt.⁸

As the writer, at the beginning, had in mind using various sodium tungstates, namely, those in which the ratio of basic oxide and acid oxide varied, in the preparation of "complexes," this ratio, $4\text{Na}_2\text{O} \cdot 10\text{WO}_3 \cdot 23\text{H}_2\text{O}$, arrested his attention, and caused him to devote more time to its preparation and to the study of its behaviour, as well as to the properties of allied derivatives. Therefore, the following observations on the salt, $4\text{Na}_2\text{O} \cdot 10\text{WO}_3 \cdot 23\text{H}_2\text{O}$, are offered, which for convenience, may be designated the 4:10-salt.

HISTORICAL.

Despite the possibility of repetition, a brief historic sketch is submitted. Vincenz Forcher,⁶ experimenting with the normal salt ($\text{Na}_2\text{O} \cdot \text{WO}_3 \cdot 2\text{H}_2\text{O}$) followed a hint pre-

¹ Wolcott Gibbs, *Am. Chem. J.*, 1, 218 (1879).

² See also Dammer, "Handbuch der anorganischen Chemie," 3, p. 639; and Abegg, "Handwörterbuch der anorganischen Chemie," 4, p. 791.

³ Gibbs, *Am. Chem. J.*, 1, 2 (1879).

⁴ Scheibler, *J. prakt. Chem.*, 83, 278 (1861).

⁵ Dammer, *Ref.* 2, p. 664.

⁶ Forcher, *J. prakt. Chem.*, 86, 240 (1862).

⁷ See also Lefort, *Ann. chim. phys.*, 15, 9, 97 (1876).

⁸ *Z. anorg. Chem.*, 96, 139 (1916).

viously given by Riche,⁹ namely, passed carbon dioxide through an aqueous solution of the normal salt for several days, and obtained the 1:10-salt. He busied himself no further with it. Other chemists had it in hand but disregarded it, thinking no doubt that it was an accidental product. But Gibbs¹⁰ gave it study, analysed it not only repeatedly, but also made the corresponding potassium, ammonium (also made by Marignac) and zinc salts thus establishing, as he believed, the 1:10 series.

FORMATION OF THE 1:10- SALT.

The writer, in due course, succeeded in making the salt by the method of Gibbs', whose observations¹¹ tell the story quite well and may on that account be given here:

The general result of my own study of the action of acetic acid upon the neutral tungstate is that we obtain the 5:12, the 9:22, or the 4:10 salt, according to the circumstances of the case, the constitution of the salt formed depending mainly upon the degree of concentration of the acid and upon the duration of its action.

The indefiniteness confessed in this quotation indicates how easily one may be led astray in the preparation of the 4:10- salt.

In the experiments of the writer definite amounts of the constituent materials were used; 100 g. of $\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$ was dissolved in 140 cc. of water and 50 cc. of glacial acetic acid was gradually introduced into the solution; the flask was cooled under running water as it became heated. Beautiful white needles separated, but on recrystallisation from water the 4:10- and 5:12- salts were the products. Were the white needles not recrystallised, but simply washed with cold water, and then analysed, the result was: water, 13.62 per cent.; Na_2O , 8.17 per cent.; WO_3 , 78.08 per cent.; approximating closely the requirements of a formula $9\text{Na}_2\text{O} \cdot 22\text{WO}_3 \cdot 51\text{H}_2\text{O}$. Many similar trials gave like results, which would mean that the preceding conditions gave in reality two salts—4:10 and 5:12. Usually there was a preponderance of the first salt, the 4:10- salt, which Jules Lefort claims to have made by pouring a saturated solution of the normal salt into an excess of glacial acetic acid in the cold,

when a white insoluble precipitate separated. This was collected, washed with alcohol, and then dissolved in boiling water. On cooling, it separated in very beautiful, transparent, oblique prisms, unalterable in the air. And yet this same chemist—Jules Lefort, p. 96 of the same Journal, advises that sodium bitungstate, $\text{Na}_2\text{O} \cdot 2\text{WO}_3 \cdot 6\text{H}_2\text{O}$, is produced when glacial acetic acid is added (to acid reaction), to a saturated solution of normal sodium tungstate. After a day or two the salt was said to separate in long, prismatic needles. At least fifty experiments were made by the writer in the hope of obtaining this bitungstate. The working conditions in one trial will suffice to indicate the manner of procedure.

One hundred and fifty gr. of normal sodium tungstate was dissolved in 100 cc. of water. To this solution was added 15 cc. of crystallised (glacial) acetic acid in portions at a time of 0.5 cc. to 1 cc. The liquid warmed. When 13 cc. of acid had been added sodium acetate separated. After 72 hours the liquid was poured from the crystals adhering to the flask, and these were then washed four or five times with cold water, after which they were dissolved in warm water. In the course of a few hours crystals appeared. The water content of these was determined and found to be 14.10 per cent., approximating 14.02 per cent., the water content of the 5:12- salt. In the filtrate from these crystals a second salt appeared. Its analysis gave 12.86 per cent. of water, 8.45 per cent. of sodium oxide, and 77.67 per cent. of tungstic oxide, corresponding to the requirements of the 4:10- salt.

Thus it occurred in the many other experiments conducted with the greatest care. Gibbs, on following Lefort's suggestion, was "without success in any one instance, the results . . . being in all cases very different in composition." G. von Knorre¹² says: "I have twice tried to prepare this salt exactly according to Lefort's direction, but both times obtained the compound $5\text{Na}_2\text{O} \cdot 12\text{WO}_3 \cdot 28\text{H}_2\text{O}$ "; and Gonzales¹³ adds his inability to confirm the work of Lefort.

(From the "Journal of the American Chemical Society," September, 1922.)
(To be continued.)

⁹ Riche, *Jahresber.* 1857, 189; *Ann. chim. phys.*, [3] 50, 5; *Jahresber.* 1856, 372.

¹⁰ Ref. 1, p. 221.

¹¹ Ref. 1, p. 226.

¹² G. von Knorre, *J. prakt. Chem.*, N.F., 27, 84.

¹³ Gonzales, *J. prakt. Chem.*, N.F., 35, 47.

HARDWOOD DISTILLATION.

BY H. C. MERRIAM.

The green logs are first cut into 19-inch lengths, and then into 12-inch blocks. These are taken to predriers and dried by the waste gases from retorts in a counter-current. As a rule the approximate yield of alcohol is 1 gall. of 82 per cent. per cord of wood, although by careful regulation from 2-3 gallons have been obtained, and a lot depends upon efficient scrubbing. Chips and sawdust are more difficult to handle, and a process known as the Stafford process has been worked with success. Here, advantage is taken of the exothermic heat to maintain the desired temperature. Hardwood waste gives about the same yield of methyl alcohol and charcoal, but about 50 per cent. more acetic acid. When the wood is dried to a moisture content of 1-2 per cent., the acetic acid obtained is more concentrated, which renders subsequent evaporation an easier matter. A triple effect evaporator for the calcium acetate and the acid itself is attendant with many advantages. A serious competitor to the industry is the production of acetic acid from calcium carbide, but such competition is being actively contested by further research.

THE SOCIETY OF LEATHER TRADES CHEMISTS—BRITISH SECTION.

A meeting of the British Section of the S.L.T.C. was held at the Leathersellers' Technical College, 176, Tower Bridge Rd., London, S.E.1, on Friday October 6, 1922, at 10.30 a.m.

AGENDA.

Minutes of last meeting.

Reports from Analysis Committees.

The estimation of Sulphides by means of standard zinc sulphate solution, MR. W. R. ATKIN, M.Sc.

The estimation of ammonia in lime liquors without distillation, and incidentally the simultaneous estimation of caustic alkalinity, MR. W. R. ATKIN, M.Sc.

Water Soluble Matter in Leather. Its estimation and significance, MR. J. R. BLOCKEY, M.Sc.

The Sampling and Preparation of Leather for Analysis, MR. J. R. BLOCKEY, M.Sc.

EDUCATIONAL NOTES.

W. G. Foyle, Ltd., booksellers new and second hand, 121-125, Chancery Cross Rd., W.C.2, have sent their latest catalogue of scientific books. It contains particulars of a large number of standard books. Students will do well by sending for a copy before making their purchases. The prices are mostly much below the published ones.

A division of the Chair of Mining at the University of Birmingham is announced. It has been held by Sir John Cadman, but in future there will be two professional chairs. One professor will be concerned with coal and metal mining, and the other will be wholly engaged with the department and school of petroleum and oil engineering. The school of oil engineering is very largely due to the large sum of money which has come to the University from the leading persons engaged in the oil industry in Great Britain, and it is the intention of the University to build up a great school of oil engineering which, with the exception of the work done at the Imperial College, London, will be the only such school in the British Empire.

GENERAL NOTES.

d. PIMARIC ACID.

Dr. E. Knecht and Miss E. Hibbert have published a preliminary note (*J. Soc. Dyers and Colourists*, 1922, p. 221) on the preparation of d-pimaric acid, M.P. 212° C. l-pimaric acid, from French rosin is dissolved to form the sodium salt. Hypochlorite solution is next added, and the mixture allowed to stand overnight. The crystalline mass is separated by decantation, dissolved in water, reprecipitated with H_2SO_4 , and recrystallised from alcohol. This was found to be the most suitable method for isolating d-pimaric acid, and the yield is about 10 per cent.

THE INSTITUTE OF METALS.

As a result of the recent very successful meeting of the Institute held at Swansea, steps are now being taken to form a South Wales local section of the Institute in that town.

From the programme of meetings recently issued, we gather that the coming session will be a full one. The North-East Coast Local Section, with headquarters at Newcastle-on-Tyne, has for chairman the Hon. Sir Charles A. Parsons, K.C.B., F.R.S., and for vice-chairman Professor H. Louis, M.A., D.Sc., A.R.S.M.

Prospective members, as well as existing members, are allowed to attend the meetings of the Institute and its local section.

Dr. W. Rosenhain, F.R.S., head of the Metallurgy Department of the National Physical Laboratory, Teddington, will deliver the May lecture of the Institute on May 2, 1923.



This list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 24753—Atack, F. W. Manufacture of anthraquinone and derivatives thereof. Sept. 13.
 24897—Chemical Engineering Co., Ltd.—Process of producing intimate mixtures of substances and obtaining chemical products therefrom. Sept. 14.
 24974—Galloway, H. Pipes for use when immersed in chemical liquids. Sept. 15.
 24854—Giescke, C.—Process of agglomerating mixtures of fine ore and fuel in shaft furnaces. Sept. 14.

Specifications Published this Week.

- 185137—Atack, F.—Anthraquinone dyestuffs.
 185124—Sulman, H. L.—Treatment of ores containing copper silicate.

168566—Clem, Dr. R.—Process of filling pulp boilers with heated sulphite lye.

176770—Blanc, G. A. Method for the separation of chlorides of aluminium and potassium present in mixed solutions obtained in the treatment of leucite.

Abstract Published this Week.

Chlorates: Hypochlorites. Patent No. 183671.—An invention for the manufacture of chlorates and hypochlorites, more particularly the former of calcium or magnesium by chlorination of the corresponding hydroxide, and to the preparation of potassium chlorate therefrom, has been Patented by Mr. M. Wilderman, of 72, Fellows Rd., Hampstead.

A dilute suspension of calcium or magnesium hydroxide is chlorinated, to which fresh material is added from time to time, until a solution of chlorinated products of 60-64° Tw. is obtained. For example, milk of lime containing about 50 gr. Ca (OH) in suspension is prepared in a mixer agitated by the stirrers and the valves, being closed is pumped to the top of two towers through which it descends into a vessel. A distributing-plate, together with abonite-coated glass balls, serves to distribute the liquor and expose a very large surface to the action of the chlorine, while at the same time preventing the deposition of solid matters in the towers. Chlorine, of a suitable concentration, passes through the towers, entering at the base and leaving at the top. The liquid in the vessel is agitated by the stirrer and returns by siphon into the mixer. Thence it is again circulated through the towers. As the chlorination proceeds, fresh lime is periodically introduced into the mixer, through an inlet. The temperature during chlorination is kept below 70° C. by using diluted chlorine, and if necessary, by adding water to the liquor in the mixer. The product of the process, a solution of calcium chlorate and chloride, and possibly hypochlorite, of 60-64° Tw., is pumped from the mixer and filtered. If it is desired to prepare potassium chlorate, potassium chloride in an excess of 2 per cent. over the theoretical amount is added, and the bulk of the chlorate allowed to crystallize at atmospheric temperature. The mother liquor is diluted, if necessary, until there is present preferably 45-50 gr. calcium chloride in 100 gr. of water, when the liquor may be cooled to -20° C. to separate further quantities of potassium chlorate, without simultaneous separation of ice or of calcium chloride. It is convenient to connect the outlet of the apparatus to a similar apparatus in which comparatively fresh milk of lime is being treated.

Then when the liquor circulating in the first unit has been completely chlorinated, the valves are closed, and the partly chlorinated lime in the second unit is pumped into the mixer for treatment as described above. Preferably, however, the conveyance of liquor is avoided by reversing the order of the units, and conducting the chlorine first to the second unit and then to the first unit, the mixer of which contains fresh milk of lime. The chlorine mains are provided with connections to enable this to be done. The with connexions to enable this to be done. The process may be applied to the production of concentrated hypochlorite solutions.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3262

MINERALS DEPOSITED BY BACTERIA IN MINE WATER.

OBSERVATIONS IN THE KIMBERLEY DIAMOND MINES.

At a meeting of the "Diamond Fields Mining Institute," held in Kimberley on July 7th, 1922, with Mr. A. F. Williams, General Manager of De Beers Consolidated Mines, in the chair, Mr. John Parry, the Company's Chief Chemist, described some abnormal mineral deposits found in the De Beers Mine.

In November, 1917, several specimens of very unfamiliar looking minerals were handed into the Laboratory for analysis and report.

Although work had been carried on in this mine for at least 30 years prior to this date, nothing of a similar nature seems to have been observed before. Indeed, it was not until haulage operations had been discontinued for nearly ten years, viz., since 1908, that their presence had been noted at all.

In the Kimberley Mine, where mining operations had been curtailed for a briefer period than this, a few small specimens, identical in character and composition to some of those from the De Beers Mine, have been obtained from a small cavity in the walls of the shaft.

In all the other mines, where work has been maintained uninterruptedly, no such minerals have been known to occur.

It is important to note that all these minerals were found either in the shaft itself, or on the floor of certain levels closely adjacent to the shaft.

A very cursory inspection served to convince anyone familiar with the ordinary minerals found on the numerous working levels of the mine, of the unusual character exhibited by these particular specimens.

The samples chemically examined were as follows:

No. 1.—A long cylindrical piece, which formed only a small portion of a large deposit, found occupying the entire length of a vertical iron pipe, 180 feet long by 6 inches in diameter, erected in the Prospect Shaft of the mine, starting at the 1860 ft. level and terminating at the 2040 ft. level.

The exterior surface of the cylinder is of an entirely different colour to the mass of the core, being a dirty greyish white, while the mass is of a deep cinnamon brown. This surface, too, is rough and covered with innumerable shallow depressions; while the interior surface is brilliantly black and with peculiar undulatory oval elevations, i.e., of somewhat botryoidal characters.

The *photograph* (Fig. 1) exhibits the cylindrical outline; and a *photomicrograph* (Fig. 2) exhibits a good idea of the interior surface with the peculiar undulations.

The cylinder as shown does not represent the full thickness of this pipe core as originally found, for its total diameter is

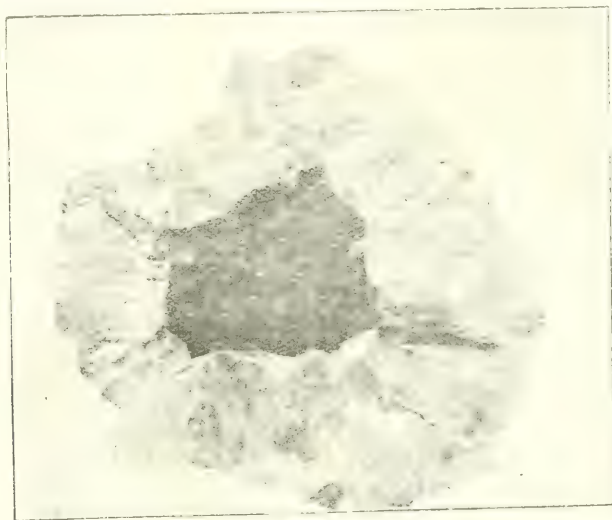


Fig. 1

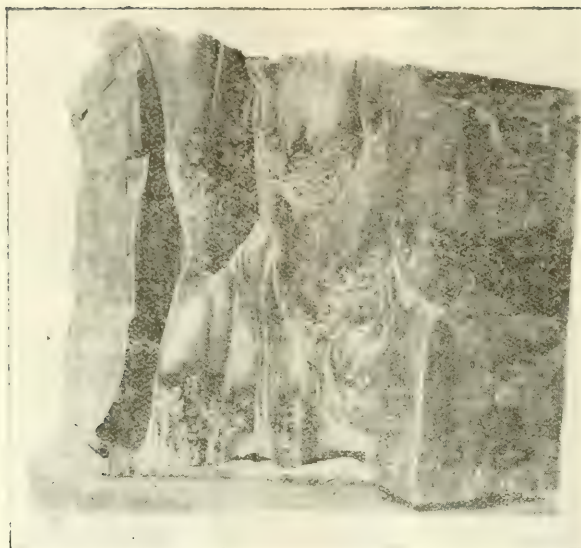


Fig. 3.

only $4\frac{1}{2}$ inches, while the full diameter of the pipe is 6 inches. Between this coloured portion of the core and the pipe wall was another inch or so of a *white* deposit. This white portion was rather soft and so loosely adherent that a vigorous tap with a hammer on the pipe easily detached it, and permitted of the ready removal of entire pieces of the solid core. None of this white portion was preserved by the miner who discovered the material. All that remains of it is the dirty white skin just alluded to. This remnant is not particularly soft and adheres pretty firmly to the rest of the core. Sufficient of it, however, was eased off for purposes of analysis.

The whole mass of the material is very brittle, and possesses a peculiar fibrous appearance.

Sample No. 2: This sample consisted of thin fragments of a scale which I collected personally on the 1,760 ft. level. The pieces were removed from the surface of some water lying in a depression on the floor of the tunnel. The whole surface of this water was covered with it as with a sheet of ice. There were many other pools and tunnels on this level, all similarly covered. In some there was a bulging of this surface coating, as though considerable pressure was being exerted beneath; while in others, there was evidence that this pressure had been great enough to fracture this surface skin, and the fractured portions, being of

greater sp. gr. than the water, were found lying at the bottom of the liquid, and such portions, when taken from the water, could be fitted into the broken surfaces. The thickness of this skin averaged 1 millimetre. It was opaque and of a faint brownish tint, and very brittle.

The pressure alluded to was in all probability due to an accumulation of gas, but at the moment I had no means available for collecting any of it for analysis, and on a subsequent visit I found all the surfaces had been broken.

I was unable to obtain any definite information as to the length of time required for this solid skin to form on these pools, for though the mine had been idle for ten years, it was only when the miner (Mr. Waddington) was placed in charge, about seven months prior to my visit, that any observation was made as to the occurrence of this peculiar deposit. From his remarks I assume that possibly only several months were needed for their formation.

Composition of No. 2 Sample.

	%
Calcium Carbonate	87.75
Magnesium Carbonate	6.34
Silica	1.32
Iron Oxide and Alumina	0.66
Moisture	2.00
Organic Matter	1.92
	99.99

Sample No. 3: This sample also occurs as sheets covering pools of water. They are of equal thickness to Sample No. 2, but are of a uniform blood red colour. Held before a strong light they are semi-transparent and of a homogeneous structure. Fragments measuring 12 x 10 inches were easily procured, and were not so brittle as Sample No. 2, and were strong enough to resist any gas pressure from beneath, as all the specimens met with were perfectly flat. The upper surface was fairly smooth, but here and there on the underside small clusters of minutely globular particles occurred, identical in composition to the sheets. In some places a second sheet had been formed immediately beneath the first in almost optical contact. The insertion of a knife blade, however, between the two sheets caused a clean separation.

These samples were found on the 2,040 ft. level only.

Composition of Sample No. 3.

	%
Calcium Carbonate	90.25
Magnesium Carbonate	5.46
Silica	0.44
Iron Oxide and Alumina	0.40
Moisture	0.72
Organic Matter	2.16
	99.43

Samples No. 4: These samples are even more remarkable than the pipe core (No. 1). They consist of fragments of the tunnel rock (so called basalt), which have become coated while lying on the floor of the tunnel with the same deposit that occurs in the iron pipe.

The fragment illustrated in the *photograph* (Fig. 3), when first discovered, was as completely enveloped with the foreign material as an egg with its shell. The exposed surface of this, like the sample from the pipe, is brilliantly black, and perfectly smooth and glassy. The underside is only a little less bright than the upper, which is accounted for by its lying in contact with the dirty floor of the tunnel, and is also less smooth, as this surface shows an exact impress of the irregular ridges and depressions of the floor, as though it had been pressed down on it in a semi-solid condition, like a seal on warm wax. When this black coating was fractured, it was seen (as the photo shows very distinctly) that it consisted of two layers, though curiously enough the surface of the innermost layer was as brilliantly black and glassy as the outer one, and could be easily separated. Evidently the deposition of the second coat must have occurred very long after the first.

The nucleus of another one of these samples, from which the black coating had been more completely removed, consisted of a piece of the tunnel rock (? basalt), 6 inches long by 2 inches wide, and varying from $\frac{1}{2}$ to 1 inch thick. It was very irregular in shape and angular.

The two coats varied in thickness: the lower between $\frac{1}{16}$ to $\frac{3}{8}$ of an inch; the upper sometimes reaching $\frac{1}{4}$ of an inch. In spite of the angularity of this stone, the outer surface of the complete specimen was smooth and roughly dome shaped, entirely concealing the irregular shape of the internal fragment of rock.

Quite a large number of such specimens were found on this level (1922) on all the



Fig. 2.

hibiting a similar confluent surface, and a double coating, and only differing from each other in size.

The occurrence of these deposits struck me as so anomalous that I was curious to see for myself the conditions under which they were discovered. Accordingly, accompanied by one of the laboratory assistants (Mr. Falck) and Mr. Waddington (the miner in charge), I descended this De Beers Mine in March, 1918. We descended the Prospect Shaft by cage to the 1,720 ft. level, and continued from that point by upright iron ladders to the 2,040 ft. level, spending some time at various levels on the way down. The most interesting of these levels was that at 1,920 feet. The portion of the tunnel immediately adjacent to the shaft was about 9 feet high and 14 feet wide. Here, on the floor, we came across the first samples of the black shiny deposit in the process of formation.

Scattered indiscriminately over the floor were fragments of the tunnel rock and pieces of wood and iron; some already completely enveloped in the black coating, others partially so, and again others showing the very initial stage of the deposition. And the source of all this abnormal formation was just water; water as it fell in intermittent drops from various parts of the roof. At first it appeared that this water was percolating through the rock from an upper level, but subsequent examination of the water afforded evidence that this could not be so. It was really derived from water rapidly streaming down the walls of the shaft itself, some of which, on reaching the opening of this level, would be carried along the roof between the innumerable minute ridges by capillary attraction, and fall ultimately and irregularly as drops. Beyond 6 feet from the shaft no drippings at all occurred, though the tunnel was composed of the same kind of rock for many yards further in.

Bottles were placed beneath the more rapidly falling drops, and a gallon of this water collected.

On analysis this water yielded the following data:

In parts per 100,000.

(a) *Salts and Acids:*

Calcium Oxide	3.08	parts
Magnesium Oxide	1.00	"
Sodium Oxide	339.60	"
Potassium Oxide	1.41	"
Silica	2.70	"
Iron Oxide & Alumina	1.70	"
Carbon Dioxide	58.96	"
Sulphur Trioxide	300.09	"
Chlorine	34.00	"

742.54

less Oxygen = to Chl. 7.66

734.88

Organic matter also present.

(b) *Probable Combinations:*

Calcium Carbonate	5.5	parts
Magnesium Carbonate	2.1	"
Sodium Carbonate	133.58	"
Sodium Sulphate	532.65	"
Sodium Chloride	53.98	"
Potassium Chloride	2.69	"
Silica	2.70	"
Iron Oxide and Alumina	1.70	"

734.90

The stone illustrated in the *photograph* (Fig. 3), and all the samples alluded to in No. 4, were picked up on this level, while the water was still dripping on to them. Here, too, the upper end of the pipe which had contained the core illustrated in Figs. 1 and 2, was exposed. Seven months prior to my visit this opening had been covered over with a plank, and during even that short period the continual dripping of the water had produced on its surface a thin deposit consisting of the same peculiar black material as upon all the other samples.

From this point we descended to the 2,040 ft. level by the iron ladder. Water was trickling down this ladder *continuously* and all the rungs were completely covered with the black deposit, the lowermost ones being perfectly smooth and extremely slippery. Portions of the coating were chipped off for analysis. At the bottom of the shaft (2,040 feet down), there lay a mass of contorted wire rope, which looked as if it were covered with molten pitch, so bright and black was it from long accumulation of this deposit.

(To be continued.)

THE SOCIETY OF CHEMICAL
INDUSTRY.

MANCHESTER SECTION.

"THE HYDROGENATION OF FATS."

The Manchester Section of the Society of Chemical Industry held its first meeting for the session 1922-23 at the Textile Institute, October 6th. Dr. E. Ardern presided, and Dr. E. F. Armstrong, the President of the Society, was also present.

The Section is making a special effort to increase the membership of the Society, and for this purpose each member has been sent, with the annual agreement, a prospectus setting out the advantages of membership of the Society of Chemical Industry and also enclosing the usual form of application for membership. It is further pointed out that now is the most suitable moment for chemists to join the Society, as the year commences in January, when the new Volume of Proceedings and Review commences.

The Chairman said that the next meeting would be a joint one, between the Manchester Sections of the Society of Chemical Industry, the Society of Dyers and Colourists, the Institute of Chemistry, and the Manchester Literary and Philosophical Society. They were fortunate in having Dr. F. W. Aston, of Cambridge, to come and speak to them about "Isotopes." Professor Bragg, as a representative of the Manchester Literary and Philosophical Society, would preside at the meeting. There was also something in the nature of an innovation to announce. A joint meeting had been arranged between the members of the Manchester Section and the Liverpool Section. This joint meeting would be held in Manchester, and a paper would be read by Dr. Levinstein.

It was hoped that next Session another joint meeting would be held in Liverpool. Reciprocity of that character could not but be helpful to the general interests of the Society, and also be very advantageous to the members of the two sections. There were now over 600 members in the section, and it was the opinion of the hon. Secretary that that number could be easily increased. No one need be frightened by the fact that the syllabus showed the list of ordinary meetings to be filled. The hon. Secretary would be quite willing, provided the Committee of the Section approved of the papers submitted, to arrange for additional meetings.

In introducing the President to the meeting the Chairman said they felt that Dr. Armstrong was admirably qualified to fill the Presidential chair, not only with distinction, but with the utmost possible credit to the Society. His high scientific attainments, his extreme originality of thought, and his keen business sense, a combination which has made him so eminent in the industry, could not but be extremely beneficial when applied to the general interests of the Society.

The President of the Society, Dr. E. F. Armstrong, F.R.S., then delivered an address, entitled, "PRACTICE AND THEORY IN AN INDUSTRIAL PROBLEM."

The main object of the few words I shall say to-night is to illustrate to you the extreme breadth of chemical problems, and the necessity for breadth both in the training and in the mind of the chemist if he is to succeed in his profession. The problem I have chosen is one which the force of circumstances has brought me personally closely into touch with, and therefore one which I do happen to know a good deal about. It is also a problem which I think is suitable for demonstration, and the problem is that of fat hardening, or, as it is known, the hydrogenation of fats. Dealing with the matter, in the first place historically, a laboratory investigation carried out by an eminent French savant, led to the discovery that if you pass certain organic substances together with hydrogen over finely divided metals, that reduction of these organic substances took place; that is to say, if they contained an unsaturated linkage that hydrogen was added to these linkages and they became saturated. That sort of fact was well known, or fairly well known, in connection with such metals as platinum and palladium, but it was a definite advance in our theoretical chemistry when nickel was found to have this power. Sabatier, who discovered this, naturally exploited the field as rapidly as he could. Among other things he tested the behaviour of the unsaturated fatty acids and fats towards this new reagent, with very indifferent success.

Then let us pass from the laboratory to that other class of chemist, the great class of people who are always trying to turn the facts which they read in the literature to profitable account. Among others, a certain Dr. Norman saw the beauty of Sabatier's observations on the fat industry. He tried very hard successfully to apply

Sabatier's discoveries. He found, as any of you will find in tackling a problem of such magnitude, with limited capital, that the difficulties on the chemical side were small but on the plant side very large. The process passed out of Dr. Norman's hands to that of a larger or more powerful firm, and they again found that, perfect as Dr. Norman's work had appeared to be, there was a very great deal to be done to gain more of a plant nature, of a chemical nature, before the process could be worked out.

I think it is illuminative to allude to some of those difficulties, because they will demonstrate the hundreds of ways in which the chemist has to exercise his ingenuity; how he has to be master of all trades, and how considerations of all kinds, in addition to those of the text book equations, enter into his daily life. Take the problem of fat hardening. Nothing could be simpler in theory: an unsaturated double bond, hydrogen and a catalyst, and you have your unsaturated fat. In practice, first of all, twenty or twenty-five years ago, hydrogen was only wanted in the laboratory, and on a small scale for balloons; that is to say, nobody knew how to make pure hydrogen in quantity cheaply. Therefore, the would-be hardener of fats had to find out how to make hydrogen. Electrolytic hydrogen was, of course, an attractive source, but on the other hand the costs of the plant, the prime costs, and the lack of any outlet for oxygen, which, of course, is formed at the same time, proved great difficulties in the way of making cheap hydrogen by that process. Alternate methods, acids on iron, and various methods, all broke down from the point of view of cost; and the only method which to the manufacturer seemed to promise success was that of taking water gas, which, roughly, is 40 per cent. CO. and 40 per cent. H. and getting rid of the CO. Now even the manufacture of water gas in those days, and that is not so very long ago, was in a very crude state. You could buy producers, but the life, and the repair cost, and so on, left much to be desired. Therefore, your would-be carrier-out of the chemical process found that, in the first place, his energies were dragged right back to what was almost a gas engineering, at any rate a chemical engineering, problem of his producer plant.

Well then the water gas problem—to get from that to hydrogen—there are obviously two methods of doing it; the one to scrub

out the CO., which, of course, was developed by the Badische Company, the other to make use of the reaction between CO. and steam to give you CO₂ and hydrogen. That is done by passing your CO. over iron oxide, that is to say your water gas, to give you iron in the free state, and CO₂, stopping that current, and running steam at a proper temperature over your iron; in that way decomposing the steam into hydrogen and iron oxide. You will carry out what I might call a cyclic reaction of that kind; first the passage of one gas, and then the passage of another gas, at the proper temperatures to get reaction. The hydrogen had to be free from the material that was fed in first, CO. All this presented problems of great difficulty. Originally, these problems were solved, more or less empirically, by dint of hard work on the part of the chemist on the spot, making practical, careful trials, and keeping data added by the engineer. In later days, the physical chemist has come to our assistance, and by a proper use of dynamics and various heat equations, and so on, has done much to facilitate the establishment of the ideal conditions of the laboratory. But, in the main, such work, valuable as it is, merely served to confirm the results which were arrived at empirically by the hard-working men on the spot.

Dr. Armstrong then dealt with the production costs of hydrogen, and stated that the electrolytic process of making hydrogen suffered from a high capital cost, unless it was carried out in a country with unlimited cheap water power. The relative commercial values of saturated and unsaturated oils were next discussed.

Dr. Armstrong then dealt at some length with the question of the catalyst, and the importance of obtaining a large surface area with the aid of pumice stone, kieselguhr, etc. The surface was very delicate and sensitive, and must be very carefully preserved, and there must be no over-heating of the catalyst. There was a wonderful literature based on catalyst poisons—and also a very wonderful jargon. It all amounted to this: that if anything acted injuriously on the surface the activity of the catalyst was reduced.

The hardening reaction took place quite fast. It was done in big vessels, a good many tons at a time. The determination of hardening value took some little time, and the determination of the melting point took a long time. The determination of

the refractive index, a physical method, was the only quick method.

The theory of the reaction was then dealt with by Dr. Armstrong, who illustrated his formulae on the blackboard, and mentioned the work done by Lord Rayleigh, Hardy, Adam and Langmuir.

In conclusion, Dr. Armstrong said that work of the kind he had indicated could only be done as the result of team work. Team work could only be done as the result of the utmost loyalty, self-sacrifice and good feeling. His experience, limited as it was, had left him with a feeling that the training chemists received the analytical training, that was to say the training of suspicion had made them much less ready to mix together, much more critical of their fellow chemists, than was desirable in the best interests of the profession. He thought the greatest good the Society had been doing, was doing, and could do, was to keep on bringing them together in the most friendly way possible, in order that they all might understand what one another were thinking and doing.

The proceedings closed by the Chairman proposing a vote of thanks to Dr. Armstrong for his address.

BRITISH ASSOCIATION.

FUEL ECONOMY

(Continued from Page 218.)

Another difficulty in testing cooking ranges and the like is the question of "residual heat." The heat capacity of any cooking range is considerable; when put into operation the structure at first absorbs a large proportion of the heat generated, which remains after the useful operations are discontinued, and is only gradually dissipated thereafter. In making calculations from the results of a given test, this "residual heat" cannot be ignored unless the cooking operations have been continuous and uniformly conducted throughout, but in ordinary practice the apparatus is rarely used in such a continuous manner. And as such "residual heat" is usually much larger in amount than the total quantity utilised, it is evident that the efficiency cannot fail to be low in any practical case, and will vary greatly according to the weight of the appliance and the length and extent of the cooking operations.

The determination of any true efficiency can only be made by raising the apparatus to, and maintaining it in, a "steady state"

as nearly as possible, during which period valid observations on running efficiency can be made. It is, therefore, necessary to maintain the temperature as constant as possible over a long period in the steady state, and to integrate the entire results over a period of many hours.

The numerical results obtained during my experiments have in all cases been verified by the subsequent use of the same appliance in cooking a standard weighed menu, and there has been found to be a reasonably close correspondence between the fuel consumed during the practical operations and the figures experimentally determined.

The four principal sources of heat usable in cooking ranges are solid fuel, gas, electrical energy, and oil fuel. Fairly complete investigations have been made of solid fuel and gas, but electrical series are in progress at the time of writing, and cannot be spoken of with the same degree of confidence as in the other two cases. The oil methods have not been investigated at all.

Of these four, solid fuel is by far the most difficult to handle in an experimental sense. It is impossible to measure the instantaneous rate of combustion. This cannot by any means hitherto discovered be maintained as constant as is necessary for really accurate instantaneous observations, and to maintain a true "steady state" in which the temperature of the range itself is kept accurately constant from hour to hour is not possible. Results can only be obtained by prolonging the experiment and obtaining a final result by a process of integration.

When a charge, however small, of fresh solid fuel is added to a glowing fire, the resulting combustion is essentially variable. When the rate of stoking is maintained artificially uniform, this variation of the reading takes the form of cyclical variations only approximately of sine character. Another considerable difficulty relates to the intensity of the draught. The same total rate of combustion can be produced in a variety of different ways by varying simultaneously the thickness of the fire and the intensity of the draught. Each such combustion results in a variation in the observed result.

The measure of the combustion is effected by analysing the flue gases. It was found impossible, with a range as ordinarily constructed, to obtain any such value of the CO_2 content of the flue gases as

would correspond to really efficient operations with the ordinary commercial type of range. The general value showed that from eight to ten times the chemically necessary minimum of air was used. A high CO_2 value can only be secured by artificially suppressing the in-leakage of air. The value of the CO_2 content in any given appliance was found to be a correct measure of the efficiency.

With gas there are similar difficulties with regard to the surplus air, but not with regard to constancy of condition. With electricity there are no experimental difficulties, provided that the voltage of the supply is maintained constant.

Experimental Method.

Oven. The interior temperature in an oven is a function whose significance is very small, for the following reasons: (1) the reading of the same thermometer in different parts of the oven varies widely; (2) several thermometers of different type, all correct, and all, therefore, reading the same, when immersed, for instance, in hot oil, take up widely different readings when placed together in the same oven, essentially because the temperature of any object placed in any conditions is such that the net time rate of gain or loss of heat is zero.

Heat is lost or gained by any such object by radiation and convection. The relative influence of these two in any given environment depends on the size, shape, and radiativity of the surface of the bulb. Apart from any question of dimensions, no measurements of efficiency by means of thermometer readings would, therefore, in any case be possible. There is, in fact, no such function as the "interior temperature," and the expression "mean interior temperature," is meaningless, except when its physical meaning is arbitrarily laid down. The only function to which this expression can reasonably be applied is the rate at which heat is transmitted to some extended object of conventional standard size, radiativity of surface and shape, placed in the oven, and of such size as to occupy a large part of the space. The expression "efficiency" can only have a definite meaning when the object to which heat is communicated is precisely defined in these respects.

Exhaustive trials were made with vessels of standard shape filled with water, by observing the rate of rise of temperature, and calculating the transmission therefrom.

This general method has the fatal disadvantage that great experimental difficulties are introduced, and with a large object in the oven having a rising temperature no sort of "steady state" can possibly be maintained. The efficiency also varies considerably according to the temperature of the object to which heat is communicated.

A more convenient calorimeter is a coil of blackened copper pipe, through which a uniform stream of water is maintained. Special devices were designed and made for maintaining constancy in the water flow. The water may be at any temperature for which the efficiency is required. The flow is regulated so that the rise in temperature between in-flow and out-flow is not great. The coil as a whole can be maintained at a constant mean temperature. This method has the great experimental advantage that one reading of the difference in temperature between in-flow and out-flow suffices to give the current rate of transmission, and the current variations in the thermal condition of the oven can, therefore, be determined.

The observed efficiency varies according to the temperature at which the coil is maintained. It is, therefore, necessary to lay down an arbitrary temperature at which all observations shall be made. If that temperature is high the resultant efficiency falls so low at low rates of combustion—even in extreme cases to zero—that its value cannot be accurately determined. As it is necessary to obtain a curve of efficiencies at all rates of combustion, it is, therefore, necessary to keep the mean temperature of the coil low, so that low rates of combustion may be included in the observations.

The temperature of the coil is of very great importance in the case of an ordinary gas oven. Where the temperature is low it enables the total heat of combustion to be brought into account; whereas when it is high the net heat only is available.

The use of gas enables much more accurate observations to be made, as a close approximation of the steady state is easily attainable by careful regulation of the rate of combustion. The latter can be controlled in the case of an oven so that any desired rate of transmission is maintained. In this case the principal difficulty is to determine how to deal with the difference between the gross and the net calorific value of the gas.

With a cold coil in the oven, a considerable part of the latent heat in the water vapour in the products of combustion may be communicated to the coil. The water appears as condensation on the surface of the coil, and drips down into the base. Thus obviously a portion of the latent heat is utilised. When the temperature is high there is no such condensation, and therefore no utilisation of this fraction of the heat of combustion. Whether and to what extent this latent heat is utilised in the actual cooking of an article of food it is impossible to say: probably some portion in the earlier stages, and later a re-evaporation of the same water originally condensed.

It will be evident that the efficiency as observed with this coil calorimeter will vary according to the surface area of the coil, or, what is the same thing, according to the size of the oven in which the coil is placed.

In order to compare, on a rational basis, ovens of different size, it was necessary to investigate the question of the variation of apparent efficiency according to the size of coil used, and to specify the standard loading for an oven of any given size. It was found that when an oven is loaded to its fullest practical capacity the surface of all the food is approximately half the surface of the oven plates. This was, therefore, laid down as the standard loading.

The final efficiency therefore determined was the ratio between (1) the heat communicated to a coil whose exterior surface was half the interior surface of the oven when kept at a constant temperature, and (2) the amount of heat in the quantity of standard fuel burnt per hour. This function varies according to the rate of combustion, the efficiency increasing with increasing combustion. Its value was determined for three different rates, and a curve drawn through the three experimental points so obtained.

Hot Plate.—The efficiency in this case is the ratio of the maximum hourly amount of heat which can be communicated by the hot plate to ordinary cooking vessels to that in the fuel consumed per hour. This efficiency is fairly constant at all rates of combustion. The hot plate is covered with standard cooking vessels, each containing a weighed quantity of water, the rate of rise in which is determined.

Hot-water Supply.—This efficiency is the ratio between the heat communicated to the water in a weighed and measured cylinder and that in the fuel consumed. 20lb. of fuel are used for this test.

SUMMARY OF RESULTS.

The following table gives a summary of the usual values obtained by the methods outlined in the foregoing appendix. It is to be understood that the phrase "commercial" means a range or appliance as supplied by makers and used in an ordinary manner, and that the term "specially designed" refers to appliances designed by me for these tests which, though expensive in construction, are thoroughly practical in character.

SOLID FUEL APPLIANCES.

<i>Oven.</i>	Found Efficiency per cent.
Highest value with specially designed range	9.5
High values with commercial ranges	4.0 to 5.0
Usual values with commercial ranges from	2.0 to 3.0
Lowest value with commercial range	0.8

Hot-Water Supply.

Highest value with specially designed semi-independently fired boiler	42.0
High values with commercial appliances	15.0 to 20.0
Usual values with commercial appliances from	8.0 to 15.0
Lowest value with commercial appliance	4.8

Hot Plate.

Highest value with specially designed appliance	21.0
High values with commercial appliances	4.0 to 12.0
Usual values with commercial appliances	2.5 to 5.0
Lowest value with commercial appliance	1.14

GAS APPLIANCES.

Oven.

Highest value with specially designed oven	55.0
Highest value with commercial oven	38.0
Lowest value with commercial oven	17.0

Hot Plate.

Highest value with specially designed appliance	60.0
Highest value with commercial appliance ..	35.0
Lowest value with commercial appliance (old pattern)	17.0
<i>Griller alone including boiling vessel standing over griller.</i>	
Highest value with commercial appliance	19.0
Lowest value with commercial appliance ..	16.6

A. H. BARKER.

[CONTRIBUTION FROM THE JOHN HARRISON
LABORATORY OF CHEMISTRY, UNIVERSITY OF
PENNSYLVANIA.]

THE SODIUM TUNGSTATES. I.

BY EDGAR F. SMITH.

(From the "Journal of the American
Chemical Society," September, 1922.)

(Continued from Page 222.)

Therefore, it would appear that Forcher's method and that of Gibbs were the best suited for the preparation of the 4:10- salt, although the writer found that if to 100 gr. of normal sodium tungstate, dissolved in 100 cc. of water, there be gradually added formic acid to a distinct acid reaction, there will appear, after 24 hours, an abundant yield of the 4:10- salt. His experience leads him to regard this procedure as superior to that in which acetic acid is employed. The 4:10- salt was the only product. The 5:12- and 9:22- salts were not observed, so that the 4:10- product could readily be obtained pure by one or more recrystallisations from water. It was also shown that Forcher's procedure was superior to that in which acetic acid, ordinary or glacial, was used.

It is interesting to note that Forcher^o alludes to the fact that once, when endeavouring to make sodium metatungstate by adding tungstic acid to a boiling solution of the normal salt, his work was interrupted, and upon his return he found crystals which analyzed for the 4:10- salt. This was, too, the experience of the writer, who obtained a very abundant yield of 4:10- in this way. Indeed, the scheme offers a very simple method for the preparation of the latter salt.

The writer, on one occasion, added a calculated amount of tungstic acid (enough to yield the 5:12- salt) to a boiling solution

of normal sodium tungstate. The liquid was filtered, and crystals separated. On analysis these showed 14.02 per cent. of water; 8.16 per cent. of Na_2O ; and 77.82 per cent. of WO_3 , in harmony with the requirements of the 5:12- salt.

In the determination of the tungstic trioxide in these various salts, Gibbs' modified Berzelius method was used. The sodium oxide was estimated both directly and by difference.¹⁴

PROPERTIES OF THE 4:10- SALT.

These have received scant notice. The common opinion is that the crystals of the salt are monoclinic in form. They effloresce rapidly in dry air, and upon resolution in water considerable heat is evolved. Their solubility is, according to Forcher, one part in 12.6 parts of water at 22°; according to Lefort, 100 parts of water at 15° dissolve 16 parts of the salt; according to the writer, 100 parts of water at room temperature dissolve 19 parts of the salt.

The specific gravity of the salt was found to be 4.3, the mean of three determinations.

The melting points of normal sodium tungstate, the 5:12- salt, the 4:10- salt, the 9:22- salt, and the sodium metatungstate were repeatedly determined with these results.

1. $\text{Na}_2\text{O} \cdot \text{WO}_3 \cdot 2\text{H}_2\text{O}$:665°. The liquid fusion was colourless and transparent as water.

2. $5\text{Na}_2\text{O} \cdot 12\text{WO}_3 \cdot 28\text{H}_2\text{O}$:705.8°. The liquid was very yellow in colour. The cooled mass was crystalline and yellow in colour for quite a while after congelation.

3. $4\text{Na}_2\text{O} \cdot 10\text{WO}_3 \cdot 23\text{H}_2\text{O}$:680.8°. Again the liquid was yellow in colour and retained this colour until quite cold, when it was crystalline and white, with a faint blue tint.

4. $9\text{Na}_2\text{O} \cdot 22\text{WO}_3 \cdot 51\text{H}_2\text{O}$:683°. The liquid was yellow in colour, even after cooling.

5. $\text{Na}_2\text{O} \cdot 4\text{WO}_3 \cdot 10\text{H}_2\text{O}$:706.6°. The meta salt melted with comparative ease. The deep yellow colour of tungstic acid predominated both while it was liquid, and when the molten mass became solid.

If, for a moment, we arrange the salts referred to above as follows:

(1) $\text{Na}_2\text{O} \cdot \text{WO}_3$ 1:1 665°	(2) $5\text{Na}_2\text{O} \cdot 12\text{WO}_3$ 1:2.4 705.8°	(3) $4\text{Na}_2\text{O} \cdot 10\text{WO}_3$ 1:2.5 680.8°
(4) $9\text{Na}_2\text{O} \cdot 22\text{WO}_3$ 1:2.444 683.3°	(5) $\text{Na}_2\text{O} \cdot 4\text{WO}_3$ 1:4 706°	

interesting conclusions are apparent. Among these it is plain that (1) and (5) represent the two extremes, and it is disappointing that the ratios between basic oxide and acid oxide as they would exist in $\text{Na}_2\text{O} \cdot 2\text{WO}_3$ and $\text{Na}_2\text{O} \cdot 3\text{WO}_3$, and as Lefort thought he had made evident, appear not to exist. v. Knorre, it is true, made $\text{Na}_2\text{O} \cdot 2\text{WO}_3$, by fusing together calculated amounts of sodium hydroxide and tungsten trioxide, but when the anhydrous body was brought into solution, the latter yielded no crystalline deposit, even upon protracted standing.¹⁵ It is most regrettable that Lefort's experiences have not been confirmed by subsequent investigators. Probably all of these have overlooked some little step in the preparation process, though confident that they proceeded in accordance with the printed directions. Or, it may be that Lefort failed to note a step, to him trivial, but which if known might have aided later colleagues to confirm his observations, which are numerous and bear the imprint of careful work.

A further examination of the ratios of basic and acid oxides in the 5 salts, represented above, discloses that (4)—the 9:22-salt—has a ratio (base to acid) close to those of the second and third salts—the 5:12-salt and the 4:10-salt. The 9:22-salt we owe to Wolcott Gibbs. It resembles in some points the suggestion he gave for the production of the 4:10-salt. Indeed, the writer's product prepared in the manner of Gibbs, analysed as follows: H_2O , 13.75 per cent.; Na_2O , 8.08 per cent.; and WO_3 , 78.19 per cent. These results would pass well for the requirements of a 4:10-sodium salt and, therefore, a doubt does come to mind as to whether the 9:22-salt is a distinct individual.

When Gibbs described the preparation of the 5:12-salt, according to Scheibler,¹⁶ he cautiously added: "If the proportion of chlorhydric acid is just sufficient to give an

union-red reaction with litmus, crystals are obtained, which are either a combination or a mixture of equal molecules of the 4:10- and 5:12- salts. Their analyses agree closely with the formula $5\text{Na}_2\text{O} \cdot 12\text{WO}_3 \cdot 4\text{Na}_2\text{O} \cdot 10\text{WO}_3 \cdot 41\text{H}_2\text{O}$." Gibbs left this point undecided, although he did make a zinc salt by adding a cold solution of zinc sulphate to a cold solution of the 9:22-sodium salt. A precipitate formed at first and then redissolved, but when the zinc sulphate was in small excess white needles separated. These proved insoluble in water. They were dried for some time upon woollen paper. Their analysis led to the formula $9\text{ZnO} \cdot 22\text{WO}_3 \cdot 66\text{H}_2\text{O}$. Gibbs had found the zinc salt of the 4:10 series to have the formula $4\text{ZnO} \cdot 10\text{WO}_3 \cdot 29\text{H}_2\text{O}$, while Gonzales¹⁷ speaks of zinc *para*-tungstate as having the formula, $5\text{ZnO} \cdot 12\text{WO}_3 \cdot 37\text{H}_2\text{O}$.

It crystallised in white needles. These formulæ added together would give the formula $9\text{ZnO} \cdot 22\text{WO}_3 \cdot 63\text{H}_2\text{O}$, which differs from the 9:22 salt of Gibbs by only 3 molecules of assumed water of crystallisation.

It must, however, be said that whenever the writer made Gibbs' 9:22-sodium salt, he found upon its recrystallisation that the two salts, 5:12- and 4:10-, appeared, so that he is sceptical in regard to the individuality of the 9:22-salt.

In the extensive work, for so it was, made upon the action of acetic acid and normal tungstates, hoping that the bitungstate of Lefort would be found, it was noticed that the crystals which separated after solution in water and recrystallisation left a mother liquor which grew alkaline upon concentration. These alkaline liquors separated from 4:10- and 5:12- salts with eventually not a little sodium acetate, but the liquid from the latter had a yellow colour and gave the alkaline reaction to which reference has just been made. The thought was entertained that perhaps at the beginning, when acetic acid reacted with the normal tungstate, sodium bitungstate was really produced, and that in its solution hydrolysis occurred with the production of 4:10- and 5:12-sodium salts. Patiently, all mother liquors were evaporated, the separating salts removed from time to time, then finally the liquid was allowed to evaporate spontaneously, when cauliflower-like white masses separated.

15. Ref. 12. p. 27.

16. Ref. 1, p. 225.

17. Ref. 13. p. 51.

These were dissolved in little water and permitted to separate spontaneously. Their analysis showed that these residues were nothing more than sodium hydrate mixed with sodium tungstate, which must be regarded as hydrolytic products of the several sodium tungstates formed on acting with acetic acid upon normal sodium tungstate. At present this seems the only reasonable explanation of what evidently occurred during the process of concentration.

PROPERTIES OF THE 4:10- SALT.

On testing the 4:10- salt, in solution, with various metallic salt solutions, these behaviours were noted.

The addition of a cold aqueous solution of zinc sulphate produced a white precipitate soluble in a slight excess of zinc sulphate. From this solution, on standing, white needles separated in stellar aggregations. These were the 4:10- zinc salt described by Wolcott Gibbs.

Cadmium sulphate occasioned a white voluminous precipitation, insoluble in an excess of cadmium sulphate as well as in cold and hot water, thus differing from the zinc salt.

With cobalt sulphate and nickel nitrate precipitates appeared soluble in an excess of the precipitants. That with cobalt was quite granular.

A solution of zirconium oxychloride ($\text{ZrOCl}_2 \cdot 8\text{H}_2\text{O}$) gave (in a solution of the 4:10- salt) a heavy, white and extremely gelatinous precipitate, insoluble in water and in an excess of the precipitant.

Lanthanum sulphate gave a white, insoluble gelatinous precipitate. This also occurred with praseodymium and neodymium nitrates. There was nothing remarkable about these products. They proved to be insoluble and were easily decomposed by nitric acid, even in the cold.

Uranyl nitrate gave a flocculent yellow coloured precipitate (with the 4:10- salt). It redissolved in a slight excess of the uranyl salt. The solution was filtered, when a white granular powder separated.

Ferric ammonium sulphate gave a curdy, slightly yellow precipitate, insoluble in an excess of the precipitant.

Alum produced a copious, finely divided precipitate, which curdled on agitation. It proved perfectly insoluble.

Chromium potassium sulphate occasioned a precipitate. It was greenish-grey in colour, gelatinous and insoluble in excess of the reagent and also in large volumes of water.

Lead nitrate produced a white, gelatinous precipitate, insoluble in an excess of the precipitant and also in hot water.

Hydroxylamine hydrochloride (in a solution of 4:10- salt) caused no precipitation.

With hydrazine sulphate a rather voluminous, somewhat flocculent, white precipitate appeared, insoluble in cold water, but dissolving rather freely in hot water, and was not soluble in an excess of hydrazine sulphate.

GENERAL NOTES.

THE UNITED STATES TARIFF.

PUBLICATION OF TEXT.

On Thursday, the *Board of Trade Journal* published the text of all those portions of the United States Customs Tariff which are of interest to merchants and manufacturers in this country. The dutiable list, and the free list will be given in full, and also the special provisions, which confer powers upon the President to vary the rates of customs duties, and to change the classifications, and also in certain circumstances to impose an "American Valuation" as a basis for assessing *ad valorem* duties. The clauses making changes in the Administrative Provisions will also be given.

Board of Trade,

10th October, 1922.

INDIAN INDUSTRIES AND LABOUR.

The August number of the *Journal of Indian Industries and Labour* contains two articles of special interest in connection with the question of the extent to which assistance and control by the State is desirable and justifiable in the field of industrial enterprise. The Hon. Mr. C. Y. Chintamani, Minister of Education and Industries in the United Provinces, deals with the subject in an article entitled, "The limits of State aid to industry," with special reference to the work of the Department of which he holds charge. Mr. A. Y. G. Campbell contributes the first part of an article on the functions of provincial departments of industries, in which the whole question of State assistance is exhaustively and carefully reviewed. Mr. Campbell speaks from experience, as he himself held for some years the post of Director of Industries in Madras, which may fairly claim to be the pioneer of organised State assistance to industry, and was recently placed

on deputation by the Government of India to study the subject in Europe.

In an extract from the Presidential Address delivered to the Mining and Geological Institute of India, in January, 1922, by Dr. Leigh Fermor, Officiating Director of the Geological Survey of India, the author describes in a convincing manner the practical utility of a State geological department. Dr. Fermor declares that in royalties alone the receipts accruing annually to the Provincial Governments and other owners of mineral rights in India, in respect of the eight most important minerals, excluding salt and saltpetre, amount to a minimum of 84 lakhs of rupees.

Mr. J. K. Mehta, Secretary of the Indian Merchants' Chamber and Bureau, gives a short account of the composition and functions of chambers of commerce in the United Kingdom, the United States of America, the British Colonies, and the principal countries on the Continent of Europe. The author shows that the main characteristic which distinguishes the British from the Continental model is its complete independence of Government.

Probably little is known by the general public of the extent to which the owners of mills and factories in India have actually introduced measures to safeguard and improve the welfare of their employees. The account which Miss Broughton gives in this number of the *Journal* of the work which is being done to-day in furtherance of this object is distinctly encouraging.

The possibility of making a complete and accurate census of the industrial production of India has been receiving much attention for some time past. Those interested in the subject will find in the *Journal* an account of the manner in which such statistics are obtained in the United Kingdom, the United States of America and Canada, contributed by Rai Bahadur D. N. Ghosh, the officiating Director of Statistics. Mr. Ghosh's article gives the reader an idea of the extent of the organisation and of the expenditure required to enable a census of this nature to be carried out.

The *Journal* contains the usual summarised accounts of the activities of the Provincial Departments of Industries during the preceding quarter, while Mr. S. H. Jhabvala contributes under the heading of "Miscellaneous Notes" an account of the Bombay Working Men's Institute, which was opened by the late Sir Vithaldas Thackersey in February last.

BIRMINGHAM UNIVERSITY.

BIRMINGHAM UNIVERSITY NEW
PROFESSORSHIPS.

Professor R. R. Thompson, who has held the office of Director of Lands and Mines in Trinidad, has been appointed the new professor of oil mining at the University of Birmingham. Twelve years ago he was a lecturer on the staff of Sir John Cadman at the University. The new professor of coal and metal mining is Professor K. N. Moss, until recently assistant professor. Sir John Cadman will continue to act as Honorary Adviser to the University on all mining subjects, and Dr. Haldane as Director of the Coal Mining Research Laboratories.

EGYPT.

TENDERS INVITED FOR SUPPLY OF GENERAL STORES.

His Majesty's Consul-General at Alexandria has informed the Department of Overseas Trade that the Egyptian Postal Administration at Alexandria are inviting tenders for the supply of general stores for the year 1923-24.

Tenders, on the proper form and accompanied by a deposit of 2 per cent. of the total value of the offer, will be received by the Egyptian Postal Administration at Alexandria up to noon on the 15th November, 1922.

The range of stores required is fairly extensive and varied, and includes mailbags, boots, fuel, ready-made furniture, hardware, house linen, rolling stock and accessories, steel stamps, special stationery, disinfectants, flags, paint, wicker work, house-keeping requisites, etc. The complete specification, together with conditions of tender and tender form, may be seen by United Kingdom firms interested upon application to the Department of Overseas Trade (Room 82), 35, Old Queen Street, London, S.W.1.

It should be noted that representation in Egypt is essential. The Department will be pleased to furnish to firms not so represented the names of United Kingdom firms who have Egyptian branches prepared to handle contracts on behalf of third parties. (Ref. 9212/1/FE/GP).

BOARD OF TRADE ANNOUNCEMENT.

SAFEGUARDING OF INDUSTRIES ACT. PART
II.—NO. 2 ORDER: GAS MANTLES.

The Board of Trade have made an Order, which comes into force forthwith, applying

Part II. of the Safeguarding of Industries Act, to Mantles for incandescent lighting and component parts thereof, whether finished or not, manufactured in Germany. The effect of the Order which is published in the Statutory Rules and Orders series (Safeguarding of Industries (No. 2) Order, 1922), is to impose an import duty of 33½ per cent. *ad valorem* on the class of goods referred to, if manufactured in Germany.

In exercise of the powers conferred on them by Section 5 of the Act, the Board of Trade have directed that Certificates of Origin shall be required so far as concerns the class or description of goods covered by the Safeguarding of Industries (No. 2) Order, 1922, in the case of goods consigned from all foreign countries in Europe.

The necessary instructions have been issued to His Majesty's Consular Officers in the countries concerned, and the form of Certificate of Origin already prescribed by the Board of Trade in connection with the previous Order (No. 1) will be applicable.

Board of Trade,

7th October, 1922.

DIRECTORY FOR THE BRITISH GLASS INDUSTRY.

PRELIMINARY ANNOUNCEMENT.

The Council of the Society of Glass Technology has approved the preparation of a Directory for the British Glass Industry.

This Directory will contain the classified names of all firms, associations, societies, trade unions, educational and research institutions interested in the manufacture and wholesale supply of glass and glass articles, and in the supply of raw materials, plant and machinery to the industry.

It is hoped that the Directory will be published at the end of the year, and members of the Society will have the privilege of purchasing it at a reduced rate. The price will be announced in November.

ROYAL MICROSCOPICAL SOCIETY.

20, HANOVER SQUARE, W.1.

The session 1922-1923 opened with a conversation on Wednesday, October 11, at the Examination Hall, 8-11, Queen Sq., Bloomsbury, W.C.1. A full programme of papers has been arranged for the monthly meetings from October to June, 1923. The Presidential address, by Professor Frederic J. Cheshire, O.B.E., F.Inst.P., will be delivered on January 17.

BOOKS RECEIVED.

An Introduction to the Chemistry of Plant Products, by PAUL HAAS, D.Sc., Ph.D., and T. G. HILL, A.R.C.S., F.L.S. Pp. viii. + 140. Vol. II. 1922. Messrs. Longmans, Green & Co., 39, Paternoster Row, E.C.4. 7s. 6d.

The Origin of Spectra, by PAUL D. FOOTE and F. L. MOHLER, U.S. Bureau of Standards. Pp. viii. + 250. 1922. The Chemical Catalog Co., Inc., 19, East 24th Street, New York, U.S.A. \$4.50.

The Nitrogen Industry, by J. R. PARTINGTON, M.B.E., D.Sc., and L. H. PARKER, M.A., D.Sc., F.I.C. Pp. xi. + 336. 1922. Messrs. Constable & Co., Ltd., 10 & 12, Orange Street, Leicester Square, W.C.2. 21s. net.

Grundzüge der Angewandten Elektrochemie, by DR. GEORG GRUBE. Pp. xi. + 268. 1922. Verlag von Theodor Steinkopff, Dresden and Leipzig. Unbound 8s. 4d., bound 10s. 3d.

The Microscope, by CONRAD BECK. First Edition. 1921. Pp. 144. London: R. & J. Beck, Ltd., 68, Cornhill, E.C. 2s. 6d.

Researches on Cellulose, by CHARLES F. CROSS and CHARLES DOREE. Pp. x. + 253. 1922. Vol. IV. of the series "Cross and Bevan," 1910-1921. Messrs. Longmans, Green & Co., 39, Paternoster Row, E.C.4. 15s. net.

Theories of Organic Chemistry, by DR. FERDINAND HENRICH. Translated and enlarged from the Revised Fourth German Edition of 1921, by TREAT B. JOHNSON and DOROTHY A. HAHN, Ph.D. Pp. xvi. + 603. 1922. Messrs. Chapman & Hall, 11, Henrietta Street, Covent Garden, W.C.2. 30s.

Coal and Allied Subjects, by F. S. SINNATT, M.B.E., M.Sc., &c., and Associates. Pp. 204. Compendium 1, 1922. Messrs. H. F. & G. Witherby, 326, High Holborn W.C.1. 15s. net.

NOTE ON THE ATOMIC WEIGHT OF BORON.

BY F. H. LORING.

Referring to the chemical atomic weight of boron, an early determination of this element revealed the value 11.0; a later determination by Smith and Van Haagen revealed the value 10.90; a still later determination by O. Höngschmid and L. Brickenbach revealed the value 10.82.

Aston's research on the masses of the boron isotopes revealed the values 10 and 11. Referring to page 111 of Aston's book, "Isotopes," 1922, the mean mass, which should correspond to the chemical atomic weight determination, is estimated at 10.75 ± 0.07 .

Referring now to my scheme for calculating isotopes, *Chemical News*, April 16, 1920, vol. CXX., p. 181, or see vol. CXXI., p. 105, or "Atomic Theories," page 148, the following is given:

Element.	$a \times \text{He}$	$a \times b \times c \times d$	Isotopes and Prop. No.	Mean and Exp. Mass.
B	$2 \times 4 = 8$	3	$= 11 \quad 1^3 \times 11 = 10.93$ $= 9 \quad 3^3 \times 9 = 10.93$	10.9
Correcting on account of the lower mass isotope being 10, and introducing the Höngschmid value, the scheme becomes—				
B	$2 \times 4 = 8$	3	$= 11 \quad 3^3 \times 11 = 10.77$ $= 10 \quad 2^3 \times 10 = 10.77$	10.82

It will be seen that my value, 10.77, is in close agreement with both Aston's approximate mean value and that of Höngschmid and Brickenbach.

In the above scheme, in which $3^3 = 27$

and $2^3 = 8$, the calculation is as follows:—

$$\begin{array}{r} 11 \times 27 = 297 \\ 10 \times 8 = 80 \\ \hline 35) \quad 377 \\ \quad 10.77 \end{array}$$

NOTE ON THE ISOTOPES OF IRON.

BY F. H. LORING.

The isotopes of iron are of considerable interest, as this element has the strongest (ferro-) magnetic property. Whether the mass values will have any significance in this connection is of course uncertain. It

is now believed that the atomic number and the structure of the atom are determining factors; but, be this as it may, Aston has recently published in *Nature* (Sept. 2, 1922) the isotopes of iron, which are 54 and 56. These values agree with those of my isotopic scheme published in this Journal (1920, vol. CXXI., p. 105), of which the following is an excerpt from the table:—

Element.	$a \times \text{He}$	$a \times b \times c \times d$	Isotopes and Prop. No.	Mean and Exp. Mass.
Fe	$13 \times 4 = 52$	4	$= 56 \quad 4^4 \times 54 = 55.78$ $= 54 \quad 2^3 \times 56 = 55.78$	55.84

Referring to Aston's experiment, there was some difficulty experienced in registering the 54 value, so that further confirma-

tion of this discovery may be necessary before it becomes fully accepted.

NOTICES OF BOOKS.

(1) *Cours de Chimie Organique.*

(2) *Cours de Chimie Inorganique.* Par FRED. SWARTS, Troisième Edition, revue et augmentée. Pp. 674 and 734. Bruxelles: Maurice Lamertin, Editeur. 1921 and 1922. Price 45 fr. and 50 fr. Professor Swarts' Textbooks of Organic and Inorganic Chemistry have now reached their third edition.

These volumes are not intended as complete treatises, but form courses of study in the two main branches of the Science.

Professor Swarts has followed the traditional methods of presentation of the subject and has dwelt upon the physico-chemical aspects of chemistry in both the organic and the inorganic volumes. In the essentially descriptive portions, the details are commendably brief but adequate.

Some sections are dealt with more fully and contain later information than others. Recent work on the Constitution of Atom, the Isotopes, and Catalysis, have been incorporated. The volume on organic chemistry does not appear to differ essentially from the preceding ones, but some of the recent developments are mentioned and other revisions have been made.

For students who wish to become familiar with scientific French the volumes are very suitable, being at the same time reliable textbooks for consultation on points of theoretical importance. J.G.F.D.

The Properties of Electrically Conducting Systems. by CHARLES A. KRAUS. Pp. 415. New York: The Chemical Catalog Co. Inc. 1922. Price \$4.50.

During the past thirty years, a number of American scientists, including some of the foremost physical chemists of the day, have carried out a vast amount of experimental work upon Conducting Solutions.

Professor Kraus, who has himself done good research work in this branch of Physical Chemistry, has now collected much of the material and results of these extensive researches, which have hitherto remained obscure in the various journals and transactions of Scientific Societies.

But whilst the readers of Professor Kraus' volume will be impressed by the large amount of physico-chemical researches performed by American scientists, they cannot but regret that much valuable and cognate work on this subject by British and especially Continental chemists has been ignored.

Selection of matter was indeed inevitable and the author has given a good and clear account of the American researches upon the conductance of electrolytic solutions and the properties directly dependent thereon. Solutions in non-aqueous solvents receive very detailed treatment. Much of the book will be new to many readers. Previously unpublished matter, especially from the author's laboratory, is also incorporated.

This monograph, which is one of those issued under the auspices of the American Chemical Society, merits the careful attention of all Physical Chemists.



This list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 25377—Aguillon, J. E.—Recovering benzol contained in gas. Sept. 19.
 25538—Asahi Glass Co., Ltd.—Process for application of colloidal magnesium silicate as a forcing agent of manure. Sept. 21.
 25742—Barron, C. A.—Method of manufacture of a highly-concentrated aqueous solution of aluminium acetate. Sept. 23.
 25694—British Cellulose and Chemical Manufacturing Co., Ltd.—Manufacture of artificial filaments, threads, etc. Sept. 22.

Abstract Published this Week.

Cellulose Derivatives.—Patent No. 183908.—A process for preparing Cellulose Derivatives has been patented by Messrs. Plausons', Ltd., of 17, Waterloo Place, Pall Mall, London.

Acetates, ethers, and phosphoric acid and sulphur compounds are prepared by subjecting cellulose to high speed mechanical disintegration, and treating the colloidal and highly dispersed cellulose so obtained with suitable chemical reagents, the disintegration is essentially effected in a grinding-apparatus such as the colloid mill described in Specification 179124, while employing a grinding speed of 1,000 metres per minute or higher. In examples, cotton is dispersed in water in the colloid mill until the particles have a diameter of 0.8 μ , and then combined with o-phosphoric acid at a temperature of 30-50° C., and preferably after the addition of a trace of sulphuric acid. Alternatively, the phosphoric acid may be allowed to react during the dispersion of the cellulose. Dispersed cellulose is heated with acetic anhydride and acetic acid in the presence of codium acetate as the accelerator, and the acetic acid may be produced in the nascent state by means of sodium acetate and sulphonic acid; dispersed cellulose is heated with sulphur, preferably in the presence of caustic or carbonated alkali and at a temperature not exceeding 150° C., dispersed cellulose is mixed with methyl alcohol and hydrochloric acid gas introduced—a methyl ether of cellulose is formed.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3263

MINERALS DEPOSITED BY BACTERIA IN MINE WATER.

OBSERVATIONS IN THE KIMBERLEY DIAMOND MINES.

(Continued from Page 228.)

Samples of this black deposit were isolated from the (1) "pipe core," (2) "the stones," (3) the "plank of wood," and (4) the "iron rungs" of the ladder, and separately analysed.

The composition of them all is practically identical, as may be seen from the following results:—

pated every individual minute. There exists the possibility that at various times during this period of ten years, that the lime content of these waters may have exhibited great fluctuations.

Unfortunately, no records are available of any analyses having been performed on these waters between 1908 and 1917. In 1906, however, Dr. Otto Hohner examined an alkaline water from this mine, and this showed only 6.2 parts CaCO_3 per 100,000.

Since 1917, at least six samples have been analysed, and at intervals of 12 months and 2 months; but the range was always low, varying from 1.2 parts up to, but never exceeding, 7.2 parts per 100,000.

It does not seem feasible that such rapid evaporation could take place in a vertical pipe of the specified diameter, and at a temperature only a few degrees above the

	(1) Sample from Iron pipe.	(2) Sample covering Stones.	(3) Samples off plank of Wood.	(4) Sample off Rungs of Ladder.
	%	%	%	%
Calcium Carbonate	82.56	89.5	89.0	88.6
Magnesium Carbonate	8.77	5.81	5.2	5.9
Silica	0.38	0.14	0.4	0.2
Iron Oxide and Alumina ..	2.80	0.14	0.28	0.8
Moisture	3.92	1.83	0.90	1.3
Organic Matter	1.71	2.66	1.56	2.6
Sodium Sulphate	trace	trace	2.55	trace
	100.01	100.08	99.89	99.4

Some contained traces of P_2O_5 and NH_3 .

The weight of material found in the pipe was approximately estimated. The sp. gr. of the material was 2.6, and its average thickness 2 inches. The pipe was 6 inches in diameter, and its length 180 feet, the whole of which was coated internally with this deposit. Calculated out, this indicates a weight of 3.64 tons. There is at least 200 lbs. of it which consists of organic matter.

Reverting to the analysis of the water, which produced this deposit, it will be seen that the amount of Carbonate of Lime and Magnesia present is ridiculously small, and only exceeds slightly their actual solubility.

To produce this 2.64 tons of deposit, nearly 14 million gallons of this water would be required; and further, it would be necessary to evaporate it to complete dryness; and to accomplish this in 10 years would mean that 2½ gallons must be dissi-

normal, viz., about 20° C. Further, if the pipe were filled with flowing water, the evaporation would be negligible, while if it merely trickled through—which appears to have been the normal condition—there would certainly be *some* evaporation: but even assuming it to be so large as 10 per cent., no appreciable deposition of Carbonate of Lime would be induced from so weak a solution.

A reasonable conclusion here is that a theory depending wholly and solely on evaporation, is inadequate to account for so large a deposit in so short a time. Confirmation of this inference may be justified by the following instances:—

On the 1,600 foot level in the *Wessellton* Mine there is a 3-inch *horizontal* iron pipe, which has been delivering a stream of water into the main rock tunnel for the last seven

years, at the rate of 1,200 gallons per hour. It is not a mightily rushing torrent (for the pipe is always much less than half full), so that a large surface is continuously exposed to atmospheric friction, thus favouring evaporation. The amount of lime and magnesia in the water is nearly twice that of the De Beers sample. At least 73 million gallons of water, carrying $36\frac{1}{2}$ tons of lime, have passed through that pipe in

that period, and yet there is no appreciable deposition of lime in it at all. Here the conditions of flow and the lime content of the water are far more in favour of a copious deposit than in the De Beers case, and yet none occurs.

A second instance—at the Company's Central Power Station—the water used in the condenser has the composition shown below:

Calcium Carbonate	2.59	parts	per	100,000.
Magnesium Carbonate	0.77	"	"	"
Sodium Carbonate	9.66	"	"	"
Sodium Sulphate	8.38	"	"	"
Sodium Chloride	27.48	"	"	"
Silica, Iron Oxide and Alumina	3.29	"	"	"

52.17

It varies a little from time to time. Say the average is 5.5 parts of lime per 100,000.

The average daily flow of this water through the condenser is 9,000,000 gallons. The condenser has 4,000 tubes, and exposes a cooling surface of 13,000 square feet. The temperature reached is well over 38° C., and often reaches 60° C.—quite high enough to drive off nearly all the semi-combined CO_2 , which holds most of the lime in solution. Yet with all these favourable conditions for deposition, it takes 2 years for a scale one-fortieth of an inch to form. It amounts to only 0.13 per cent. of the total lime in solution.

If, in our De Beers Mine sample, then, the temperature of the water could have been maintained at 38° C., and had been flowing through a horizontal instead of a vertical pipe, it would only have yielded $9\frac{1}{2}$ bl. of deposit instead of over 7,000 lb. That is, in the absence of any other contributory cause for the precipitation. That some other cause than evaporation was operating seemed to be very evident, though at the time I could not trace it, and the matter was left in abeyance for some time.

An opportunity subsequently presented itself for a further examination of the water causing the deposit. It was collected again as it dripped from the roof; it was quite clear and free from any suspended matter. The chemical characters of the dissolved ingredients coincided with those of the original water.

On this occasion, interruptions in the operations of analysis necessitated leaving the bottle with half its contents undisturbed

for several days on the laboratory bench. It was then observed that all down the side remote from the light, a greyish white deposit appeared, which adhered most tenaciously to the glass. The bottom of the bottle was similarly coated, but with a much thicker layer. The most violent agitation of the bottle failed to disturb either of these adhesions. The bottle had remained securely corked all this time, so that no evaporation nor loss of carbon dioxide could occur; and the fact should be emphasised, that when originally collected the water was clear and free from any suspended matter.

The water was poured off and some of the greyish deposit scraped up for examination. When treated with dilute hydrochloric acid, the substance effervesced vigorously, and subsequent analysis showed it to contain a high percentage of carbonate of lime.

This was rather a phenomenal result. Here was a deposition of carbonate of lime occurring without any evaporation whatever; without any loss of carbon dioxide; and with no chemical present to assist precipitation; nor any increase of temperature; and yet it occurred in a homogeneous semi-transparent condition.

Naturally a microscopical inspection suggested itself. Several slides were prepared and viewed with a $\frac{1}{4}$ -inch objective, and inspected very critically, for there at last appeared to emerge a hint suggesting an important contributory cause—perhaps the sole cause—in the formation of these weird deposits. The field of view was occupied

with myriads of living micro-organisms; some quiescent, but many more exhibiting considerable motility.

Both micrococci and bacilli were present, and it could be discerned, when viewed with special care, that each of the bacilli were surrounded with a transparent gelatinous envelope. It appears to me highly probable that it is the presence of this sticky jacket that enables these organisms to adhere so strongly to the glass of the bottle, or, for that matter, to anything else.

It would appear from this striking revelation that we have discovered a micro-organism capable of withdrawing calcium carbonate from solution and building it up into its own tissues *unaltered*: a sufficiently novel and startling inference.

If this inference, however, be justified, then it assists most materially in accounting for the accumulation of such phenomenal deposits, both in the pipe and on the stones, etc.

It occurred to us to ascertain if the coloured deposit from the stones and the pipe could yield any evidence that these particular bacilli might be lying dormant in this dry material. Some of the material was gently crushed; placed in a sterile test tube; covered with sterile water; the tube plugged with sterile wool, and then incubated for several days at a temperature of 21°C .

A similar tube, as control, was prepared under identical conditions, except that powdered native calcite was substituted for the coloured deposit, and incubated at the same time and temperature. After 5 days, portions were drawn off from each tube, and inspected microscopically. The "control" tube sample showed only calcium carbonate, nothing more; no living micro-organisma; neither bacilli, nor micrococci; but imagine our surprise and delight when the "deposit" sample revealed a crowd of living organisms, resembling those that had been obtained from the water itself: crowds of active micrococci and crowds of the tiny jacketed bacilli.

If these bacilli, then, be responsible for the extraction of calcium carbonate from the water, the adhesion of the deposit to the side of a vertical pipe does not now seem so surprising. For once a gelatinous colony of these organisms became attached to the pipe it was not easily dislodged; and the start once made, further accumulation was inevitable. The conditions of deposit and further growth were, in a way, ideal;

there was darkness; there was a suitable temperature (about 70°F . on the average); there was organic matter in the water to serve as food; and there was calcium carbonate for tissue building; to put it in the crisp, brief way of the scientist, the whole conditions constituted a suitable nidus for the propagation of saprophytic organisms.

At this period of the investigation (in the absence of opportunities for further biochemical experimenting), this inference of bacterial agency struck me as being too audacious to serve as more than a tentative explanation. The work was left in abeyance for some time, but in *Nature* for August, 1920, there appeared the full address of the President of the British Association, Prof. Herdman, and in it appeared this remarkably apposite paragraph:—

"The part played by bacteria in the metabolism of the sea is very important, and probably of wide reaching effect, but we still know very little about it. A most promising young Cambridge biologist, the late Mr. G. Harold Drew, now unfortunately lost to science, had already done notable work at Jamaica and Tortugas, Florida, on the effects produced by a bacillus which is found in the waters of these shallow tropical seas and in the mud at the bottom; and which denitrifies nitrates and nitrites, giving off free nitrogen. He found that this *Bacillus Calceis* also caused the precipitation of *Calcium carbonate* on a large scale in the warm shallow waters. Drew's observations tend to show that the great calcareous deposits of Florida and the Bahamas previously known as "coral muds," are not, as was supposed by Murray and others, derived from broken up corals, shells, etc., but are minute particles of carbonate of lime, which have been precipitated by the action of these bacteria."

(To be Continued.)

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

(SECTION A.—MATHEMATICS AND PHYSICS.)

THE THEORY OF NUMBERS.

ADDRESS BY PROFESSOR G. H. HARDY,
M.A., F.R.S., PRESIDENT OF THE SECTION.

I find myself to-day in the same embarrassing position in which a predecessor of mine at Oxford found himself at Bradford in 1875, the President of a Section which

is probably the largest and most heterogeneous in the Association, and which is absorbed by a multitude of divergent professional interests, none of which agree with his or mine.

There are two courses possible in such circumstances. One is to take refuge, as Professor Henry Smith, with visible reluctance, did then, in a series of general propositions to which mathematicians, physicists, and astronomers may all be expected to return a polite assent. The importance of science and scientific method, the need for better organisation of scientific education and research, are all topics on which I could no doubt say something without undue strain either on my own honesty or on your credulity. That there is no finer education and discipline than natural science; that it is, as Dr. Campbell has said, "the noblest of the arts"; that the crowning achievements of science lie in those directions with which this section is professionally concerned: all this I could say with complete sincerity, and, if I were the head of a deputation approaching a Government Department, I suppose that I would not shirk even so unprofitable a task.

It is unfortunate that these essential and edifying truths, important as it is that they should be repeated as loudly as possible from time to time, are, to the man whose interest in life lies in scientific work and not in propaganda, unexciting, and in fact quite intolerably dull. I could, if I chose, say all these things, but even if I wanted to, I should hardly increase your respect for mathematics and mathematicians by repeating to you what you have said yourselves, or read in the newspapers, a hundred times already. I shall say them all some day; the time will come when we shall none of us have anything more interesting to say. We need not anticipate our inevitable end.

I propose therefore to adopt the alternative course suggested by my predecessor, and to try to say something to you about something about which I have something to say. There is only one subject about which I have anything to say, and that is pure mathematics. It happens, by a fortunate accident, that the particular subject which I love the most, and which presents most of the problems which occupy my own researches, is by no means overwhelmingly recondite or obscure, and indeed is sharply distinguished from almost every other branch of pure mathematics, in that it

makes a direct, popular, and almost irresistible appeal to the heart of the ordinary man.

There is, however, one preliminary remark which I cannot resist the temptation of making. The present is a particularly happy moment for a pure mathematician, since it has been marked by one of the greatest recorded triumphs of pure mathematics. This triumph is the work, as it happens, of a man who would probably not describe himself as a mathematician, but who has done more than any mathematician to vindicate the dignity of mathematics, and to put that obscure and perplexing construction, commonly described as "physical reality," in its proper place.

There is probably less difference between the methods of a physicist and a mathematician than is generally supposed. The most striking among them seems to me to be this, that the mathematician is in much more direct contact with reality. This may perhaps seem to you a paradox, since it is the physicist who deals with the subject-matter to which the epithet "real" is commonly applied. But a very little reflection will show that the "reality" of the physicist, whatever it may be (and it is extraordinarily difficult to say), has few or none of the attributes which common-sense instinctively marks as real. A chair may be a collection of whirling atoms, or an idea in the mind of God. It is not my business to suggest that one account of it is obviously more plausible than the other. Whatever the merits of either of them may be, neither draws its inspiration from the suggestions of common-sense.

Neither the philosophers, nor the physicists themselves, have ever put forward any very convincing account of what physical reality is, or of how the physicist passes, from the confused mass of fact or sensation from which he starts, to the construction of the objects which he classifies as real. We cannot be said, therefore, to know what the subject-matter of physics is; but this need not prevent us from understanding the task which a physicist is trying to perform. That, clearly, is to correlate the incoherent body of facts confronting him with some definite and orderly scheme of abstract relations, the kind of scheme, in short, which he can only borrow from mathematics.

A mathematician, on the other hand, fortunately for him, is not concerned with this physical reality at all. It is impossible to prove, by mathematical reasoning, any pro-

position whatsoever concerning the physical world, and only a mathematical crank would be likely now to imagine it his function to do so. There is plainly one way only of ascertaining the facts of experience, and that is by observation. It is not the business of a mathematician to suggest one view of the universe or another, but merely to supply the physicists with a collection of abstract schemes, which it is for them to select from, and to adopt or discard at their pleasure.

The most obvious example is to be found in the science of geometry. Mathematicians have constructed a very large number of different systems of geometry, Euclidean or non-Euclidean, of one, two, three, or any number of dimensions. All these systems are of complete and equal validity. They embody the results of mathematicians' observations of *their* reality, a reality far more intense and far more rigid than the dubious and elusive reality of physics. The old-fashioned geometry of Euclid, the entertaining seven-point geometry of Veblen, the spacetimes of Minkowski and Einstein, are all absolutely and equally real. When a mathematician has constructed, or, to be more accurate, when he has observed them, his professional interest in the matter ends. It may be the seven-point geometry that fits the facts the best, for anything that mathematicians have to say. There may be three dimensions in this room and five next door. As a professional mathematician I have no idea; I can only ask the Secretary, or some other competent physicist, to instruct me in the facts.

The function of a mathematician, then, is simply to observe the facts about his own hard and intricate system of reality, that astonishingly beautiful complex of logical relations which forms the subject-matter of his science, as if he were an explorer looking at a distant range of mountains, and to record the results of his observations in a series of maps, each of which is a branch of pure mathematics. Many of these maps have been completed, while in others, and these, naturally, the most interesting, there are vast uncharted regions. Some, it seems, have some relevance to the structure of the physical world, while others have no such tangible application. Among them there is perhaps none quite so fascinating, with quite the same astonishing contrasts of sharp outline and mysterious shade, as that which constitutes the theory of numbers.

The number system of arithmetic is, as we know too well, not without its applications to the sensible world. The currency systems of Europe, for example, conform to it approximately; west of the Vistula, two and two make something approaching four. The practical applications of arithmetic, however, are tedious beyond words. One must probe a little deeper into the subject if one wishes to interest the ordinary man, whose taste in such matters is astonishingly correct, and who turns with joy from the routine of common life to anything strange and odd, like the fourth dimension, or imaginary time, or the theory of the representation of integers by sums of squares or cubes.

It is impossible for me to give you, in the time at my command, any general account of the problems of the theory of numbers, or of the progress that has been made towards their solution even during the last 20 years. I must adopt a much simpler method. I will merely state to you, with a few words of comment, three or four isolated questions, selected in a quite haphazard way. They are seemingly simple questions, and it is not necessary to be anything of a mathematician to understand them; and I have chosen them for no better reason than that I happen to be interested in them myself. There is no one of them to which I know the answer, nor, so far as I know, does any mathematician in the world; and there is no one of them, with one exception which I have included deliberately, the answer to which any one of us would not make almost any sacrifice to know.

1. *When is a number the sum of two cubes, and what is the number of its representations?* This is my first question, and first of all I will elucidate it by some examples. The numbers $2 = 1 + 1$ and $9 = 2 + 1$ are sums of two cubes, while 3 and 4 are not: it is exceptional for a number to be of this particular form. The number of cubes up to 1,000,000 is 100, and the number of numbers, up to this limit and of the form required, cannot exceed 10,000, one-hundredth of the whole. The density of the distribution of such numbers tends to zero as the number tend to infinity. Is there, I am asking, any simple criterion by which such numbers can be distinguished?

Again, 2 and 9 are sums of two cubes, and can be expressed in this form in one way only. There are numbers so express-

ible in a variety of different ways. The least such number is 1,729, which is $12^3 + 1^3$ and also $10^3 + 9^3$. It is more difficult to find a number with *three* representations; the least such number is

$$175,959,000 = 560^3 + 70^3 = 57^3 + 198^3 = 525^3 + 315^3$$

One number, at any rate, is known with four representations, viz.:

$$19 \times 363510$$

(a number of 18 digits), but I am not prepared to assert that it is the least. No number has been calculated, so far as I know, with more than four, but theory, running ahead of computation, shows that numbers exist with five representations, or six, or any number.

A distinguished physicist has argued that the possible number of isotopes of an element is probably limited because, among the ninety or so elements at present under observation, there is none which has more isotopes than six. I dare not criticise a physicist in his own field; but the figures I have quoted may suggest to you that an arithmetical generalisation, based on a corresponding volume of evidence, would be more than a little rash.

There are similar questions, of course, for squares, but the answers to these were found long ago by Euler and by Gauss, and belong to the classical mathematics. Suppose, for simplicity of statement, that the number in question is *prime*. Then, if it is of the form $4m+1$, it is a sum of squares, and in one way only, while if it is of the form $4m+3$ it is not so expressible; and this simple rule may readily be generalised so as to apply to numbers of any form. But there is no similar solution for our actual problem, nor, I need hardly say, for the analogous problems for fourth, fifth, or higher powers. The smallest number known to be expressible in two ways by two biquadrates is

$635318657 = 158^4 + 59^4 = 134^4 + 133^4$ and I do not believe that any number is known expressible in three. Nor, to my knowledge, has the bare existence of such a number yet been proved. When we come to fifth powers, nothing is known at all. The field for future research is unlimited and practically untrodden.

2. I pass to another question, again about cubes, but of a somewhat different kind. *Is every large number* (every number that is to say, from a definite point onwards) *the sum of five cubes*? This is another exceptionally difficult problem. It is

known that every number, without exception, is the sum of nine cubes; two numbers, 23 (which is $2 \cdot 2^3 + 7 \cdot 1^3$) and 239, actually require so many. It seems that there are just fifteen numbers, the largest being 454, which need eight, and 121 numbers, the largest being 8042, which need seven; and the evidence suggests forcibly that the six-cube numbers also ultimately disappear. In a lecture which I delivered on this subject at Oxford, I stated, on the authority of Dr. Ruckle, that there were two numbers, in the immediate neighbourhood of 1,000,000, which could not be resolved into fewer cubes than six; but Dr. A. E. Western has refuted this assertion by resolving each of them into five, and is of opinion, I believe, that the six-cube numbers have disappeared entirely considerably before this point. It is conceivable that the five-cube numbers also disappear, but this, if it be so, is in depths where computation is helpless. The four-cube numbers must certainly persist for ever, for it is impossible that a number $9n+4$ or $9n+5$ should be the sum of three.

I need hardly add that there is a similar problem for every higher power. For fourth powers the critical number is 16. There is no case, except the simple case of squares, in which the solution is in any sense complete. About the squares there is no mystery; every number is the sum of four, and there are infinitely many which cannot be expressed by fewer.

3. I will next raise the question *whether the number $2^{2^m} - 1$ is prime*. I said that I would include one question which did not interest me particularly, and I should like to explain to you the kind of reasons which damp down my interest in this one. I do not know the answer, and I do not care greatly what it is.

The problem belongs to the theory of the so-called "perfect" numbers, which has exercised mathematicians since the times of the Greeks. A number is perfect if, like 6 or 28, it is the sum of all its divisors, unity included. Euclid proved that the number

$$2^m(2^{m+1} - 1)$$

is perfect if the second factor is prime; and Euler, 2,000 years later, that all *even* perfect numbers are of Euclid's form. It is still unknown whether a perfect number can be odd.

It would obviously be most interesting to know generally in what circumstances a number $2^n - 1$ is prime. It is plain that

this can only be so if n itself is prime, as otherwise the number has obvious factors; and the 137 of my question happens to be the least value of n for which the answer is still in doubt. You may perhaps be surprised that a question apparently so fascinating should fail to arouse me more.

It was asserted by Mersenne in 1644 that the only values of n , up to 257, for which $2^n - 1$ is prime are

2, 3, 5, 7, 13, 17, 19, 31, 67, 127, 257; and an enormous amount of labour has been expended on attempts to verify this assertion. There are no simple general tests by which the primality of a number chosen at random can be determined, and the amount of computation required in any particular case may be quite appalling. It has, however, been imagined that Mersenne perhaps knew something which later mathematicians have failed to rediscover. The idea is a little fantastic, but there is no doubt that, so long as the possibility remained, arithmeticians were justified in their determination to ascertain the facts at all costs. "The riddle as to how Mersenne's numbers were discovered remains unsolved," wrote Mr. Rouse Ball in 1891. Mersenne, he observes, was a good mathematician, but not an Euler or a Gauss, and he inclines to attribute the discovery to the exceptional genius of Fermat, the only mathematician of the age whom anyone could suspect of being hundreds of years ahead of his time.

These speculations appear extremely fanciful now, for the bubble has at last been pricked. It seems now that Mersenne's assertion, so far from hiding unplumbed depths of mathematical profundity, was a conjecture based on inadequate empirical evidence, and a rather unhappy one at that. It is now known that there are at least four numbers about which Mersenne is definitely wrong; he should have included at any rate 61, 89, and 107, and he should have left out 67. The mistake as regards 61 and 67 was discovered as long ago as 1886, but could be explained with some plausibility, so long as it stood alone, as a merely clerical error. But when Mr. R. E. Powers, in 1911 and 1914, proved that Mersenne was also wrong about 89 and 107, this line of defence collapsed, and it ceased to be possible to take Mersenne's assertion seriously.

The facts may be summed up as follows. Mersenne makes fifty-five assertions, for the fifty-five primes from 2 to 257. Of

these assertions forty are true, four false, and eleven still doubtful. Not a bad result, you may think; but there is more to be said. Of the forty correct assertions many, half at least, are trivial, either because the numbers in question are comparatively small, or because they possess quite small and easily detected divisors. The test cases are those in which Mersenne asserts the numbers in question to be prime; there are only four of these cases which are difficult and in which the truth is known; and in these Mersenne is wrong in every case but one.

(To be Continued.)

THE SOCIETY OF DYERS AND COLOURISTS.

The Manchester Section of the Society of Dyers and Colourists held its first meeting of the session on Friday, October 13th.

Mr. Pennington moved a vote of thanks to the retiring Chairman (Dr. Knecht), for his services to the section during the previous two years, and this was seconded by Mr. Hannay, and carried unanimously.

The newly-elected Chairman (Mr. William Marshall, J.P., F.I.C., F.C.S.), then took the chair, and delivered his inaugural address.

"THE DYEING AND FINISHING OF RAMIE."

In opening his address, Mr. Marshall said that the ramie fibre was again exciting considerable interest in many parts of the world, and dyers would probably in the near future be called upon to handle large quantities of it. He thought it might be of interest to members of the Society if he brought to their notice some results which he obtained in March, 1919, and at subsequent dates.

Dr. Marshall then gave a brief resumé of the preparation of the fibre previous to the dyeing process and the finishing process, showing specimens from the different stages of such preparation. China grass, ramie, or Rhea belonged to the natural order Urticaceæ, and hence was not a grass at all, but a species of nettle somewhat resembling in appearance and habits of growth the common nettle of Europe. It was, however, a stingless, or shooting, nettle of the subdivision Bæhmeria. There were many varieties of the plant, but only two species of interest for their fibre yielding properties, namely: (1) *Bæhmeria nivea*

(white-leaved ramie), which was first known and cultivated from time immemorial under the name of *Tehou Ma*; and (2) *Bahmeria Tenacissima* (green-leaved ramie), known in India as *Rhea* and in the Malay Islands as *Ramie*. The plant was a shrub reaching 4 to 6 ft., and, in some cases, 8 ft. in height, very hardy and of rapid growth, yielding 3 or 4 crops a year without replanting. It was easy of cultivation, and practically unlimited quantities could be grown in China, Formosa, Japan, India, Malaya, Queensland, Mauritius, Cameroons, West Indies, Brazil, Mexico, and the Southern States of America to meet all possible requirements. The plant had also been grown at Kew. Attempts to utilise the ramie fibre in this country date back to the year 1814.

After the plants are cut down, the first process was the removal of the outer bark, and the separation of the bast fibres in the form of ribbons, which were then hung up to dry. A small portion at the heart of the plant was waste, as it was pithy and useless. In China the stems, as soon as cut down, are soaked in water, and the bark scraped off by native women and children with a knife or ring, or the fingers, the bast fibres being cleaned and dried in the sun. The product was the China Grass of Commerce. A mechanical method of decorticating would be of immense value, and the inventors, stimulated by the offer of the Indian Government in 1869 and 1889 of a prize of £5,000, had devoted a great deal of attention to the subject, both in Europe and America. If a machine could be made which would turn out large quantities, and would not damage the strength and other good qualities of the ribbon, the cost would be lessened, and regular supplies insured. Some machines were said to be working satisfactorily in the U.S.A., and owing to these machinery improvements there were signs that ramie would be obtainable in the raw state much cheaper, and it might prove a source of money-making to cotton manufacturers.

According to the last report of the British Cotton Industry Research Association, they had some 300 cotton plants at the Shirley Institute, Didsbury, and he (Mr. Marshall) intended to suggest to the Association that it would be useful to add a few ramie plants to their collection, so that engineers might study at first hand its properties and work out the problem of cheap and satisfactory decortication.

Most of the impurities were removed in the degumming process, and the resulting product was practically cellulose, almost identical in chemical constitution with bleached cotton and linen. The degummed fibre had most valuable properties. It ranks first of all the vegetable fibres (cotton flax, hemp, jute) in strength and durability. It was also the least affected by moisture and the atmospheric conditions, and was exceptionally white in colour, and the fibres were almost equal to silk fineness. It had a high silky lustre quite equal to linen in daylight. In artificial light it was certainly superior, and it was more hygienic than flax, hemp, or cotton, and washed better. On the other hand, flax was more uniform in length of staple, and less variable in the thickness of its individual fibres. Ramie lacked the elasticity of wool and silk and the flexibility of cotton. Yarns made from it had a tendency to be hairy, which diminished their lustre, and they had not the same smart appearance as when made from flax. This hairiness was due to the fact that the individual fibres lacked cohesion, and did not adhere to each other, as was the case with other fibres. It would not bend readily at right-angles like cotton, and unless it had been carefully treated it had a tendency to break. The fibres were frequently very broad, and at these parts were flat and ribbon-like in form, but were never twisted like the cotton fibre.

In strength and fineness the fibre equalled the best known fibres, but there was the peculiar hairiness in it, which, while enabling it to work with wool rendered it difficult to spin alone on account of its stiffness and lack of elasticity interfering with the twist, thus rendering the yarn tough, although the individual filaments had not lost their silky smoothness. These spinning difficulties had, however, been overcome, and all counts of yarn were now being produced in this country.

Broadly speaking, the coarser counts of ramie were made into ropes. The inferior qualities were utilised for the manufacture of string and fishing nets. The best counts were used for textiles, either alone or mixed with other fibres. During the last 60 years few practical problems had consumed so much time, energy and capital, as the attempt to bring China grass into use for manufacturing purposes. Some French, Japanese and Chinese silk goods are said to contain a proportion of ramie.

In China it is extensively used for mak-

ing cloth, especially the kind of cloth called "The white Summer cloth." This is a very fine material, made from the best fibre and most durable. The Chinese often wear clothes made from this grass cloth for 20 and more years; they have them dyed several times and then consider them as new clothes.

The resistance to the influence of the weather of the Chinese ships' sails made from grass cloth was well known. It was sometimes used in making sails for racing yachts when expense was no consideration.

Ramie could not be expected to take the place of ordinary cotton goods on account of its price, but for specialities and novelties there might be many openings where its valuable properties could be utilised. A good illustration of this was found in the manufacture of incandescent mantles, which were first made from cotton yarn. These were not satisfactory as regards luminosity, and had a tendency to break. Ramie was tried, and is now the principal yarn from which mantle fabrics are knitted and woven. Before the war large quantities were imported from Germany, the British makers only being able to produce a small percentage of the mantle manufacturers' requirements. The deficiency had now been made good, and British spinning plants which had rendered the country self-supporting in this respect were also able to meet all enquiries for other purposes. Mantles made from China grass had a higher and better maintained illuminating power, and were more capable of withstanding shock.

Mr. Marshall then dealt with the dyeing properties of ramie; in view of the many contradictory statements which had been published about difficulties in dyeing and fastness to light and washing. His results were conclusive that ramie was equal in all these points to cotton and flax. Direct, basic, developed, sulphur, vat, indigo, turkey red, anilin black, para red, and azoic dye-stuffs were used, and comparisons between cotton, ramie and flax were exhibited. Specimens of cloth in various finishes made from ramie and mixtures in both the mercerised and non-mercerised states were also shown in white, colours

and prints, and were characterised by their softness, lustre and silky appearance.

In concluding his address, Mr. Marshall referred to the export of ramie from China, and the enormous demand for it from Japan, which was now taking something like 90 per cent. total quantity from China. This, of course, meant that the world was getting 10 per cent. This was a most unsatisfactory state of things. If the manufacture of ramie fabrics was to be successfully accomplished in this country, it could only be by the application of the best technical skill, and the close and hearty co-operation of the Lancashire manufacturers with spinners, dyers, and finishers. In his opinion, there was no reason why Lancashire should not produce from ramie many novelties which would have a ready sale in the markets of the world.

Mr. Huebner proposed a vote of thanks to Mr. Marshall for his address, and in seconding the proposition Mr. Hannay said it would be interesting to learn what the Japanese were doing with all the ramie they obtained from China. Japan was a country which, in textiles, was very well worth while watching if Lancashire was to keep its end up.

THE FARADAY SOCIETY.

ETHYL CHLORIDE, C_2H_5Cl .

By C. F. Jenkin.

(A Contribution to a GENERAL DISCUSSION
on "THE GENERATION AND UTILISATION
OF COLD," held by the Faraday Society
and the British Cold Storage and Ice
Association on Monday, October 16th,
1922.)

Ethyl chloride is a colourless liquid a little lighter than water; as its boiling point at atmospheric pressure is 12.5°C. , it may be handled in open vessels without much loss, and may be stored in glass bottles or cylinders of quite moderate strength.

It is an anæsthetic, but must be inhaled in considerable strength before it has appreciable effect.

It is very inflammable, and considerable care must be exercised to avoid fires.

It is a very convenient material for refrigeration; the following data indicate its properties as a refrigerant:—

Latent heat at 0° C. = 93.7 cal. per gram, or C° lb. per lb.

Specific heat of liquid = 0.348 at -30°C . to 0.413 at $+40^{\circ}\text{C}$.

0.22 to 0.28.

gas (saturated)

Specific volume of liquid

at $+20^{\circ}$ is 297 c.c. per gram.

at -20° is 1305

at -30° is 1.035 c.c. per gram

at $+30^\circ$ is 1.139 " " "

The critical point is 190°C . and 54 atmospheres.

The vapour pressure curve is shown in the accompanying figure.

It does not attack metals, but for some reason not yet fully explained, the liquid does contaminate mercury, so that mercury manometers can only be used for pressures less than the vapour pressure corresponding to the room temperature—i.e., roughly for pressures less than atmospheric.

It attacks india-rubber, but vulcanised rubber tubing and corks can be used, though they leak a little. They swell considerably, but return to their original size when the ethyl chloride dries off. Pure rubber tape is softened almost to solution. Vulcanite swells moderately. It causes most woods to swell, but lignum vitæ can be used for valves, etc., when a non-conductor of heat is required. Bakelite is also useful as a non-conductor; it only swells very slightly.

Liquid ethyl chloride dissolves a small quantity of water, but can be dried by passing it through calcium chloride drying tubes. With water it forms very remarkable ice crystals; if a shallow glass of ethyl chloride is exposed to the air, it dries up and rapidly falls in temperature, and ice crystals form round the edge, condensed from the atmospheric moisture. These crystals appear to be tubular and grow rapidly, the ethyl chloride soaking up inside them as in a sponge. Similar crystals form at the throttle valve in a refrigerating machine if there is any water dissolved in the ethyl chloride and quickly choke the valve. It is important, therefore, to keep the material dry in refrigerating plants.

Ethyl chloride is a convenient cooling material for use in laboratories; when sprayed on to any object the temperature is quickly reduced to -20°C . or lower.

For mechanical refrigeration ethyl chloride is very suitable. The vapour compression cycle is the one used. The pressures corresponding to the ranges of temperature commonly required are very low, for example for a range of $\pm 20^{\circ}\text{C}$. the pressures are 19.4 and 3.5 lb. per sq. in. absolute; the compressor therefore works with a moderate vacuum on the suction side. The type of compressor generally used is a rotary pump (of the Roots Blower type). Oil being soluble in ethyl chloride cannot be used for lubrication, so pure glycerin is employed; this separates out by gravity without difficulty. The only serious difficulty

in designing the plant is to make certain of avoiding leaks on the low pressure side; all air leaking in accumulates in the condenser and has to be purged from time to time. To avoid air leaks all valve spindles, compressor shafts, etc., have to be sealed with glycerin, so that any leakage is of glycerin, not air.

Owing to the low pressures, the volume of the pump and the cross sections of the pipes are enormously larger than those in carbonic acid or ammonia plants. On the other hand the strength required is very little, which makes the machinery very safe.

Reciprocating pumps are not suitable for compressors because the piston rod, which is lubricated with glycerin, carries moisture into the pump every stroke. The writer has had great difficulties with his research plant from this cause.

The inflammability of ethyl chloride is its most serious drawback. To get over this various "non-flam ethyl chlorides" have been put on the market. These are mixtures of ethyl chloride with large proportions of ethyl bromide. The mixture is not only non-inflammable, but may be used as a fire extinguisher. Its properties as a refrigerator are not very different from those of ethyl chloride, but as it is heavier than glycerin, special separators are necessary.

Impure ethyl chloride is supplied for refrigeration; it contains a small proportion of methyl chloride which may be slightly advantageous, as it raises the vapour pressure.

The writer is carrying out a complete investigation of the thermal properties of ethyl chloride for the Food Investigation Board (Department of Scientific and Industrial Research) and complete θ - ϕ and I - ϕ charts will shortly be published.

The following communication on the measurement of low temperature was made at the same meeting by Prof. C. R. Darling.

Amongst practical devices for the measurement of low temperature, the convenience of a thermal junction, coupled to a suitable indicator is apt to be overlooked. Some years ago, when engaged upon the determination of the congealing points of certain oils and other liquids, I had constructed the instrument now shown, which consists of a flexible couple of Hoskins' alloys, and a portable indicator of the pivoted, moving-coil type. Correction for changes in the temperature of the atmospheric junction may be made by adjusting

the pointer so that its position on the scale coincides with the reading of a mercury thermometer inserted in the lid of the indicator. The scale was calibrated at the National Physical Laboratory, the lowest reading being $-200^{\circ}\text{C}.$ and the apparatus proved quite satisfactory in use. Its advantages over a pentane thermometer were that it responded more quickly to changes in temperature, and could be used in metal vessels and enclosures under conditions in which the readings of a pentane thermometer would not have been visible. A recent check of the calibration at the temperature of solid carbon dioxide showed that the instrument had maintained its accuracy. From this experience, I suggest that the thermo-electric method of measuring low temperatures might with advantage be applied in many cases where other methods are now in use.

As a means of determining the temperatures of the different parts of a large cold store, the resistance thermometer is the best at present available. When a number of these are brought to a switchboard, and arranged so as to be capable of connection to a common indicator, much care is needed in the choice of proper materials if good results are to be secured. Recently, when going through a large cold store in London, operated by ammonia refrigerators, I observed that the switchboard was located in a small office in the engine room, in an atmosphere smelling perceptibly of ammonia. The fittings on the switchboard, being constructed of brass lightly nickel plated, showed very marked corrosion, and the instrument was out of action. As an installation of this kind is expensive, every care should be taken to avoid mistakes of this kind, which tend to bring discredit on a very useful method of measuring these temperatures, and serve to prevent its more extensive use.

THE INSTITUTION OF RUBBER INDUSTRY.

MANCHESTER SECTION.

The second meeting of the session of the Manchester Section of the Institution of Rubber Industry was held at the Midland Hotel on Monday, October 17th, Mr. H. W. Hatton presiding. There was a large attendance of members.

"SYMBOLIC RUBBER."

By Mr. D. F. L. Zorn (*Chairman of the Rubber Shareholders' Association.*)

Mr. Zorn, during the reading of his paper, explained that what he meant by Symbolic Rubber was in the sense of using a piece of indiarubber for the purpose of erasing pencil marks, or, to apply other words, the rubbing out of ideas and views that were unsound. In this sense he dealt with, among other subjects, the attempted creation of watertight compartments in industry, and the hoarding of "business secrets."

For some time past he had advocated the formation of a Rubber Parliament or a Central Council for the whole industry. This notion had been derided by certain people who wrote to the newspapers (generally, he noticed, under pseudonyms and not under their own names), and these critics had usually dubbed him an idealist; apparently under the impression that this settled the whole affair, but not one of them had as yet brought forward a single solid argument against the proposal.

One of the reasons that he valued the Institution of Rubber Industry so highly was that it provided in itself a sort of nucleus for this idea of a "Rubber Parliament." Let them consider for a moment what was the bearing of this upon the sort of questions with which they were faced in the rubber industry. He would run over a short list of matters which were occupying the attention of one section or another of the industry to-day, and would start with the question of the relative position of planter and manufacturer. They were well aware what conflicting views had been expressed regarding the subject of the restriction of output of raw rubber, and the Stevenson Committee's report upon this subject. Within the last fortnight, a resolution had been passed by the Indiarubber Manufacturers' Association, protesting against the idea of such restriction. For his own part, he regarded the restriction as a temporary expedient to meet a temporary departure from normal conditions, and from that point of view he was a supporter of restriction. Nevertheless, he welcomed the fact that the Indiarubber Manufacturers' Association had passed its resolution, because the only way to come to any agreement upon such questions was to know, in the first instance, where they all stood. It was impossible to arrive at anything definite

with people who sat upon the fence and refused to come down on either one side or the other. He took it that the Indiarubber Manufacturers' Association was ready to bring forward arguments in support of the position which it had taken up. This could be compared with the arguments on the other side, and it was just the thrashing out of questions in this way which made it possible to clear up a problem. There was no necessity to allow any hostility to enter in. Some people seemed quite unable to picture anything except a never-ending fight between the planter and the manufacturer—alternations of "top dog" and "under dog." He thought that might be described as an unbusinesslike and unscientific view.

He understood that it was claimed by the American manufacturers that in respect of manufactured rubber they were able to supply goods which, in finish, and especially in colour, were far ahead of the rubber products of any other country. He would like to know whether there were good grounds for that claim, and if so, what was the explanation? Could the English manufacturer turn out coloured goods of as high a class as the American? If not, could any of their chemists tell them the reason? There was also the question of the relations between the manufacturer and the distributor—using the latter term to cover both the wholesale and retail sides. He understood that the distributor blamed the manufacturer for lack of enterprise and for not giving him what he wanted; the manufacturer, on the other hand, complained of many distributors' methods. A further point was one which had been rather forced upon his notice as Chairman of the Rubber Shareholders' Association. From letters which were constantly reaching him, he knew that the general public was under the impression that there was gross profiteering between the rubber tree and the shop counter. During the last 12 months he had found out that the rubber manufacturers had gone through a very bad time since the war: quite as bad a time in their way as the planters had endured. As far as he could ascertain, goods were leaving the factory at distinctly competitive prices. Yet when a member of the public quoted the retail price which he had had to pay for some manufactured rubber article, he could not pretend to suggest that the price was a reasonable one. Another question was that of labour difficulties.

The Rubber Growers' Association had

been steadily at work in the matter of propaganda for some time, and a campaign of collective advertising for increasing the consumption of rubber goods was now on the point of being launched.

He had used for his parable the thought of rubber in one of its commonest everyday uses—its use as an eraser—and had tried to show that what mankind stood in need of to-day in every department of life was the "rubbing out," the elimination of old beliefs, old prejudices, old fears, and especially the elimination of generally accepted but unreal limitations, and to pave the way for a real co-ordination of effort for the general welfare of the trade.

[CONTRIBUTION FROM THE JOHN HARRISON
LABORATORY OF CHEMISTRY, UNIVERSITY OF
PENNSYLVANIA.]

THE SODIUM TUNGSTATES. I.

BY EDGAR F. SMITH.

(From the "Journal of the American
Chemical Society," September, 1922.)

(Concluded from page 236.)

Benzidine hydrochloride produced a white, heavy precipitate, not soluble in an excess of the precipitant or in boiling water.

Phenylhydrazine hydrochloride was without visible reaction.

Naphthylamine hydrochloride gave a flesh-coloured precipitate, insoluble even in boiling water. Hydrochloric acid slowly decomposed it.

Aniline hydrochloride gave no precipitation.

That the ratio observed in the sodium salt (4:10) might be further confirmed, the subjoined salts were analysed. They were made by adding an excess of the respective metallic chlorides to boiling aqueous solutions of the 4:10- sodium salt. They were washed thoroughly with boiling water.

Calcium Salt.—A white granular powder, which did not melt on heating to intense redness.

Calc. for $4\text{CaO} \cdot 10\text{WO}_3 \cdot 25\text{H}_2\text{O}$: CaO, 7.48; WO_3 , 77.38; H_2O , 15.14. Found: CaO, 7.55; WO_3 , 77.20; H_2O , 15.14.

The barium and strontium salts were also white insoluble granular powders, giving results agreeing very closely with the requirements of the formulæ, $4\text{BaO} \cdot 10\text{WO}_3 \cdot 22\text{H}_2\text{O}$ and $4\text{SrO} \cdot 10\text{WO}_3 \cdot 26\text{H}_2\text{O}$.

The *nickel* salt is a greenish-white powder. The *cobalt* salt is pink in colour and very granular. Both are insoluble in hot water. Their analytical data conformed closely with the demands of the formulæ, $4\text{NiO} \cdot 10\text{WO}_3 \cdot 3\text{H}_2\text{O}$, and $4\text{CoO} \cdot 10\text{WO}_3 \cdot 35\text{H}_2\text{O}$.

The *manganese* salt, white in colour, resembled freshly precipitated calcium oxalate from a cold solution, and on standing became coarsely granular in character. The results from several analyses were concordant and pointed to the formula, $4\text{MnO} \cdot 10\text{WO}_3 \cdot 30\text{H}_2\text{O}$.

Sodium paratungstate. $5\text{Na}_2\text{O} \cdot 12\text{WO}_3 \cdot 28\text{H}_2\text{O}$.—On drying at 100° until its weight was constant this salt lost exactly 11 per cent. of its water content.¹⁸ This percentage was equivalent to 21 molecules of water which, deducted from the total water content, 28 molecules, left 7 molecules as fixed water or water of constitution. In short, this amount of water was probably combined in the form of tungstic acid (H_2WO_3), and the formula of paratungstate might well be written, $(5\text{Na}_2\text{O} \cdot 5\text{WO}_3 \cdot 7\text{H}_2\text{O} \cdot 0.7\text{WO}_3) \cdot 21\text{H}_2\text{O}$. Such a formulation would indicate that the paratungstate was an acid salt.

Upon casting about among the various sodium tungstates for a possible corroboration of the light which was thrown upon the constitution of the para salt, it was discovered that sodium metatungstate $\text{Na}_2\text{O} \cdot 4\text{WO}_3 \cdot 10\text{H}_2\text{O}$, when dried at 100° to constant weight, lost 11.7 per cent. of water,¹⁹ corresponding to 7 molecules of water, which, deducted from the total water content (10 molecules), left 3 molecules as water of constitution, so that the meta salt might be expressed thus: $\text{Na}_2\text{O} \cdot \text{WO}_3 \cdot 3\text{H}_2\text{O} \cdot 3\text{WO}_3 \cdot 7\text{H}_2\text{O}$.

The well defined barium metatungstate, $\text{BaO} \cdot 4\text{WO}_3 \cdot 9\text{H}_2\text{O}$, similarly dried, lost 8.65 per cent. of water,²⁰ corresponding to 6 molecules, which therefore would justify the formula, $\text{BaO} \cdot \text{WO}_3 \cdot 3\text{H}_2\text{O} \cdot 3\text{WO}_3 \cdot 6\text{H}_2\text{O}$.

Scheibler mentioned²¹ that on exposing metatungstic acid to a red heat, its loss in weight was 15.85 per cent., equivalent to 9 molecules of water; but, that on heating the acid to 100° until its weight was constant, the loss was 11.5 per cent., corresponding to 6 molecules of water of crystal-

lisation, which would point to the following formula, $\text{H}_2\text{O} \cdot \text{WO}_3 \cdot 3\text{H}_2\text{O} \cdot 3\text{WO}_3 \cdot 6\text{H}_2\text{O}$.

Four portions of the 4:10- salt ($4\text{Na}_2\text{O} \cdot 10\text{WO}_3 \cdot 23\text{H}_2\text{O}$) were strongly ignited and lost 13.80 per cent., 13.79 per cent., 13.81 per cent. and 13.73 per cent. of water respectively, corresponding to 23 molecules of water. Again, 4 samples of the salt were dried at 100° to constant weight, when the loss was 10.23 per cent., 10.27 per cent., 9.4 per cent., and 9.80 per cent. respectively, corresponding to 17 molecules (10.24 per cent.) of water of crystallisation, so that if this quantity be subtracted from 23 molecules, 6 molecules would remain as water of constitution and the formula of the salt might be written: $4\text{Na}_2\text{O} \cdot 4\text{WO}_3 \cdot 6\text{Na}_2\text{O} \cdot 6\text{WO}_3 \cdot 7\text{H}_2\text{O}$, which would stamp it as a very definite acid salt.

The evidence that not only the 4:10- salt but the other sodium salts to which attention has been called, were in reality acid salts suggested that their acidity might be determined.²² This was done with a 0.1 N sodium carbonate solution, using methyl orange as an indicator. In every instance the acidity was the same as indicated in the preceding formulæ. Further, conductance experiments were made, using barium hydroxide to neutralise the acid present, when the break in the conductivity curve corresponded with the work set forth in the preceding experiments. A series of experiments was plotted for the 5:12- salt, the 4:10- salt, and the 1:4- salt, with most satisfactory results, hence there is no reason why the particular salt (4:10), under discussion in this communication, should not be formulated $4(\text{Na}_2\text{O} \cdot \text{WO}_3) \cdot 6(\text{H}_2\text{O} \cdot \text{WO}_3) \cdot 17\text{H}_2\text{O}$. It could also be graphically set forth after the manner of Werner,²³ which is possible, too, for the other salts but as these are still under study, being exposed among others to X-ray analysis, further comments on their constitution will be withheld for the present, and the antiquated formulæ²⁴ retained for comparison's sake, and their use will therefore be excused.

22. Schmidt, *Am. Chem. J.*, 8, 46 (1886).

23. Werner, *J. prakt. Chem.*, [2] 77, 439 (1908); *Z. anorg. Chem.*, 69, 247, 261 (1910); 70, 73 (1911).

24. *Z. anorg. Chem.*, 70, 300 (1911).

18. *Ref.* 4, p. 287.

19. *ibid.*, 4, p. 301.

20. *ibid.*, 4, p. 307.

21. *ibid.*, 4, p. 310.

SUMMARY.

Summarised, the preceding experiments demonstrate the following points:

1. The 4:10- salt represents a very definite series among sodium tungstates.
2. Foreher's procedure leads to the 4:10- salt and not to the 5:12- salt.
3. Formic acid, acting on normal sodium tungstate, produces only the 4:10- salt.
4. The 9:22- salt is a mixture of the 4:10- and 5:12- salts.
5. The 4:10- salt is an acid salt, as proved by the difference in its kind of water content, the ready neutralisation of its acidity, and by conductance experiments during its neutralisation.
6. The analysis of a series of new salts confirms in every way the ratio 4:10 between the basic and acid oxides.

The writer has been graciously assisted in his experimental work by Messrs. E. P. Fenimore and Russell Davis, as well as by his associate, Dr. H. S. Lukens, to whom he would here express his thanks, and also to the Trustees of the Carnegie Institution in Washington for the grant which has made possible this study and kindred studies now in progress.

Philadelphia, Pennsylvania.

GENERAL NOTES.

NON-FERROUS METALS.

A pamphlet, "Research Work in Progress," has just been issued by the British Non-Ferrous Metals Research Association, of 71, Temple Row, Birmingham. The investigations in hand cover many important problems of the Copper, Brass, Aluminium, Nickel and Lead industries, as well as subjects of importance to all users of such metals. The support given to this Association by the leading firms seems to be most encouraging, but the field covered is very wide, and many of these researches, such as those on the improvement of brass, on metal polishing, and on soldering, should attract the attention and support of many other sections of industry. The user is apt at first sight to overlook the fact that he is even more interested in the improvement of quality of his raw material than the manufacturer of the metal. In the case of failure, however, it is the user who always bears the greater loss, since he sacrifices all the time and workmanship which has been

expended on the article being manufactured.

The Bureau of Information of the Association also seems to be doing excellent service in distributing to members reports of the results of the experimental researches, and acting as a live intelligence service collecting and distributing information likely to be of service to the industry from the far corners of the world.

Finally, some indication is given of the further work which the Council hope to take up when additional financial support is forthcoming, which includes problems of importance to the electrical industries, to Die Casters, and to the Tin Plate trade.

ETHYL ALCOHOL FROM LARCH.

The production of ethyl alcohol from Western Larch (*Larix occidentalis*) has been studied by E. C. Sherrard (*J. Ind. Eng. Chem.*, 1922, p. 948). The wood was extracted with water to obtain the galactan, which was then hydrolysed to galactose by means of sulphuric acid. The acid solution was next neutralised with lime, and after removing the CaSO_4 , fermented with a special culture of *Saccharomyces cerevisiae*. The woody residue was also hydrolysed under pressure, and the liquid similarly neutralised and fermented. The sum total of alcohol formed corresponded to 10.25 per cent. resulting from 29.75 per cent. of total reducing sugars produced on hydrolysis. On hydrolysis of the original wood under pressure, an average of 29 per cent. reducing sugars were formed, this giving an actual yield of 10.65 per cent. of alcohol. For fermentation the temperature of the sugar solution must be kept at 85°-90° F., and the acidity must be carefully regulated.

THE ATTEMPTED DECOMPOSITION OF TUNGSTEN.

An account is given in a recent number of the *Journal of the American Chemical Society** of some experiments carried out by Gerald L. Windt and Clarence E. Irion to obtain laboratory evidence of atomic decomposition at very high temperatures.

Tungsten was chosen for the experiment on account of its high atomic weight and very fine wires of this metal were exploded *in vacuo*, and in carbon dioxide, by a current of electricity. Temperatures as high as 20,000° (Fah.?) are said to have been obtained.

In the vacuum experiments every care possible appears to have been taken to remove all gases previous to the explosion, and the whole research has been carried out in a most thorough manner, but the results cannot be regarded as conclusive.

After the explosion of wires *in vacuo*, spectroscopic examinations of the residual gas showed the lines of helium, but whether it really was the result of disintegration of the tungsten atom, or whether it was driven out from the electrodes by the exploding current was uncertain.

The experiments in carbon dioxide gave a residue gas that was not absorbed by potassium hydroxide solution, but the authors admit that much further research will be necessary, and regret that exaggerated accounts of the work have appeared in the Press.

* *Journal of the American Chemical Society* Vol. XLIV., No. 9, Sept., 1922.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

The next meeting of the Society of Public Analysts and other Analytical Chemists will be held on Wednesday, November 1, at the Chemical Society's Rooms, Burlington House, Piccadilly, W., at 8 p.m.

The following papers will be read:—

"The Colorimetric Estimation of Pyrogallol, Gallotannin and Gallic Acid," by C. Ainsworth Mitchell, M.A., F.I.C.

"The Estimation of Narcotine and Papaverine in Opium," by H. E. Annett, D.Sc., F.I.C., and M. N. Bose, M.A.

"The Estimation of Morphine," by J. R. Nicholls, B.Sc., F.I.C.

"Further Notes on the Estimation of Potassium by Pyrophosphate and Cobaltinitrite Methods," by R. L. Morris, F.I.C.

INFORMAL DINNER.—Arrangements have been made for members and their friends to dine together at St. James' Restaurant, 178 Piccadilly (opposite Burlington House) at 6.30 p.m.

THE OPTICAL SOCIETY.

At a meeting of the Optical Society, held at the Imperial College, on Thursday, 12th October, 1922, Professor F. J. Cheshire, Vice-President, in the chair, the following papers were read and discussed:—

A Physical Study of Coma, by L. C. MARTIN, D.Sc.

A specially designed microscope objective and mounting, calculated to exhibit coma

in the absence of spherical aberration and astigmatism, are described. Photographs of a star image, taken when the amount of coma is equivalent to that for which the light distribution has been calculated by the author, are found to verify the numerical work. The photometric examination of the photographic image is carried out by a special method.

Comparison of the Structure of Sand-blasted and Ground Glass Surfaces, by F. W. PRESTON, B.Sc.

Glass surfaces smoothed or "greyed" by loose abrasives in the usual way are compared with those produced by sand-blasting. The surfaces are so similar when produced by the two methods that they are practically indistinguishable, either by the naked eye or the microscope, and the development of the structure by etching shows that the resemblance is not merely superficial, but that the structure is in fact virtually identical. Thus, it appears that mere pounding of a glass plate can, and does, produce a surface which is structurally indistinguishable from a smoothed surface of a technical order.

Messrs. Adam Hilger, Ltd., exhibited a new type of chemical spectrometer, a new model of the Bunsen-Kirchhoff spectrometer for flame spectra, a student's model of the wave-length spectrometer (constant deviation type), and an interference accessory for testing microscope stands and fine adjustments.

LITERARY INTELLIGENCE.

Atomic Form, with special reference to the Configuration of the Carbon Atom, is the title of a volume written by Edward E. Price, and which will be published almost immediately by Messrs. Longmans, Green & Co.

At the present time the constitution of the Atom is the subject of physical theories which are widely separated from the author's ideas, and many persons may be disposed to consider them as inconsistent with the latest advances of scientific thought. Mr. Price asks for a more impartial consideration of this subject; so much has yet to be discovered, so many problems have yet to be elucidated, that no theory should be rejected which helps in any way the consideration of these problems.

NOTICES OF BOOKS.

The Microscope, by CONRAD BECK. Pp. 144. London: R. & J. Beck, Ltd., 68, Cornhill, E.C. 1921. 2s. 6d.

In this book Mr. Beck describes, in an interesting way, the structure of the microscope, its accessories and their uses. The construction and the optical principles involved are described very simply, but accurately and adequately. The important matter of correct illumination for various purposes is emphasised, and the correct methods of mounting and holding specimens are also described so that the beginner may obtain most suitable conditions for studying different objects. This section will appeal also to more experienced microscopists, who will obtain useful pieces of information by a perusal of this volume.

The various types of instruments are described, and there is a useful concluding chapter which indicates the possibilities of the recreation uses of the microscope.

In addition to a complete index, there is a nappendix giving the prices of such instruments, apparatus and accessories, which adds to the utility of this cheap little volume.

Many will find it a valuable companion for use with the microscope either at work or pleasure. J.G.F.D.

BOOKS RECEIVED.

The Manufacture of Dyes, by JOHN CANNELL CAIN, D.Sc. Pp. IX. + 274. 1922. Messrs. Macmillan & Co., Ltd., St. Martin Street, W. 12s. 6d.



This list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 26116—Akt Ges. für Anilin-Fabrikation.—Manufacture of tetrakisazo dyestuffs. Sept. 27.
 26117—Blow, E. G.—Extracting and segregating soft penetrable substances from an agglomeration of such substances, and hard or impenetrable substances. Sept. 27.
 26206—Brewer, G.—Process for electrolytic separation of pure chromium in thick layers. Sept. 28.

26114—Lewis, G. P.—Molecular conversion of hydrocarbons and separation of resultant products. Sept. 27.

26022—Masters, C. L.—Process for separation of isomeric naphthylamine sulpho acids. Sept. 27.

26000—Nitrogen Corporation.—Synthesizing ammonia. Sept. 26.

Specifications Published this Week.

25232—Chemische Fabrik Griesheim-Elektron.—Manufacture of mono-azo dye-stuffs. Sept. 18.

25221—Howard, H.—Purification of hydrofluoric acid. Sept. 18.

161002—Farbwerke vorm. Meister Lucius & Bruning.—Manufacture of methylsulphites of secondary aromatic-aliphatic amines.

166896—Collard, C.—Extraction of gelatine.

185612—British Dyestuffs Corporation.—Manufacture of new triarylmethane colouring matters.

183428—Farbwerke vorm. Meister Lucius & Bruning.—Manufacture of sulphonic acids of the 2:3-oxynaphthoic acid arylides.

185779—Plausons Parent Co.—Process for the manufacture of oily pastes or emulsions from mineral and other oils.

185842—Pearson, E. R.—Electrolytic treatment of metalliferous materials containing tungsten or molybdenum.

185913—Imray, O. Y.—Manufacture of amino-alcohols of the quinoline series.

167769—Riedel, A.—Treatment of ammonium chloride.

Abstract Published this Week.

Sodium Potassium Ammonium Phosphates.—Patent No. 184206.—A patent has been granted for improvements in the preparation of Sodium Potassium, Ammonium Phosphates, invented by Mr. J. G. Williams, of 2, Melbourne Road, West Bridgford, Nottinghamshire.

Mineral or precipitated calcium phosphate or bone ash is mixed with a solution of sodium potassium, or ammonium sulphate, and the product treated with sulphur dioxide. The reaction products are calcium sulphate and a soluble phosphate corresponding to the sulphate used, a soluble sulphite being also formed when tricalcium phosphate is treated. The formation of sulphite can be avoided if one of the three molecules of sulphate required for the reaction is replaced by one of sulphuric acid, and this may be accomplished, in the case of sodium phosphate, by the use of nitre cake. No sulphite is formed when precipitated calcium hydrogen phosphate is treated, and in this case the sulphur dioxide can be recovered by heating the filtered reaction liquid. Other acids readily volatile from hot solutions, such as acetic or formic acid, or carbon dioxide, or hydrogen sulphide, may replace sulphur dioxide.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3264

MINERALS DEPOSITED BY
BACTERIA IN MINE WATER.OBSERVATIONS IN THE KIMBERLEY DIAMOND
MINES.*(Continued from Page 243.)*

After Mr. Drew's results, there appears now nothing anomalous in inferring the assistance of bacteria in producing such deposits as ours, and I am tempted to infer that it is the persistent activity of such organisms—be their origin what it may—over this long period of time that has been largely operative in producing them.

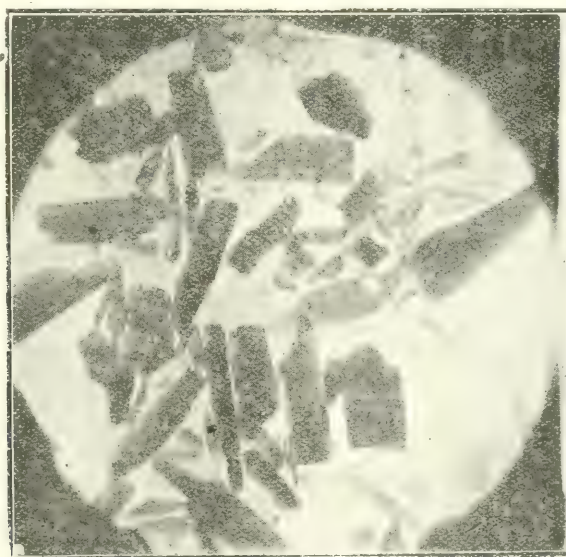
I do not claim that we have secured the actual *Bacillus Calcis* of Mr. Drew, but we do at any rate appear to have met with an organism possessing somewhat similar functions.

Further interesting features were observed, when some of the pipe deposit was finely powdered and examined under the microscope. Innumerable parallel striations were visible on nearly every particle; the spaces between them measuring from $1/600$ to $1/2,000$ of an inch (*Fig. 4*). By carefully adjusting the focus, the fractured

ends of many of these particles presented a series of little steps, revealing their structure as composed of extremely thin layers of these thin layers was quite homogeneous superimposed one upon another, and each and almost transparent.

A thin portion of the deposit from one of the stones was cut off at right angles to the surface, and ground down to a tenuity suitable for microscopical inspection. (*Fig. 5*). Owing to the brittle nature of the material, the preparation of this slide was a very tedious operation, and required the most delicate and patient handling. Even now the photo is not so good as one could wish, and only a tiny portion of the mounted specimen was sufficiently thin to allow a photograph being taken through the microscope (*Fig. 6*). This affords some idea of the very great number of layers that has gone to build up this mass.

The only feasible explanation that I can offer for the deposition of these extremely fine layers one upon the other, is that it is the work of these same micro-organisms. When first observed in our bottle of water, they had produced on the glass an extensive transparent adhesive film of matter. This water was collected as it dripped from the roof. The stones were coated by the same process of dripping. Each drop falling on the more or less flat surface of a stone tends to flow all over it, thus at the same time evenly distributing its micro-



(Fig. 4.)



(Fig. 5.)

inhabitants. As a result of the intense activity of such myriads of organisms, it is not long before a strongly adherent, thin confluent film of calcareous matter is produced. By the time another drop falls on the same spot, a bed or layer of the earlier drop is established, and the second drop then proceeds to repeat the process, and thus layers are produced continuously, though slowly, one upon another, with every succeeding drop that falls on the stone. It is to be noted, in view of the rather considerable area of the roof over which the water trickles, that the fall of drops seems fairly rapid; but the dropping is very uneven, so that a drop seldom falls from the same place except at long intervals. It is not surprising, therefore, that a great deal of time is required to produce even $\frac{1}{4}$ of an inch of these deposits on any one article.

There are, of course, alternative natural processes which suggest themselves as probable causes of such deposits. Stalactitic formations sometimes show very thin concentric layers; but these are undoubtedly produced by a process of evaporation and from fairly strong solutions of Bicarbonate of Lime; but such evaporation seems to be ruled out in the case of our samples. Moreover, none of these deposits ever assume stalactitic form.

Travertine, too, and other native forms of Calcium Carbonate, are assumed to form from the action of certain algae, which, by absorbing the semi-combined CO_2 , in the absence of free CO_2 , causes CaCO_3 to fall out of solution. This cause is not excluded here, though, so far, no evidence has turned up in support of it. Again, too, the algae do not absorb the Calcium Car-

bonate into their structure, while the organisms found on the sides of our bottle can be easily shown to consist largely of the Calcium Carbonate.

However, further bacteriological work is being carried out in connection with this matter.

There is still another problem presented by these anomalous deposits which requires elucidation, viz., the colour of the mass and the brilliantly black surfaces. What is this colouring matter and whence derived?

When fragments of the pipe core were shown to individuals curious enough to speculate as to their nature, they usually declared, without hesitation, that it was a specimen of crocidolite (cat's eye stone). After only a superficial microscopical inspection, this is not an entirely unreasonable suggestion, as the polished pieces of it do strikingly simulate that native mineral. Its fibrous structure and colour are, however, the only features it possesses in common with crocidolite. Its brittleness and chemical composition sufficiently indicate that it cannot be this substance.

Another suggestion, offered by some who were acquainted with its source, was that it was derived from the insulating material of old electric cables lying in the mine. This was quite feasible and operations were conducted to decide this point. The substances that would be removed from such material by a soda alkaline water (such as this water is) are resin and shellac. There are excellent chemical tests for identifying these two bodies, but after separating the organic matter from the calcium carbonate by a special method and submitting it to these particular tests, the answer, as a



(Fig. 6.)

Cabinet Minister would say, was in the negative.

The electric cable origin may therefore be eliminated from further consideration.

A third suggestion was that it was the fossilised trunk of a tree. When a long piece of the pipe core is inspected, it does rather resemble a tree stem with the central portion removed. But of course fossilised trees do not grow in modern 6 inch iron pipes in diamond mines.

After inspecting these various deposits *in situ*, two probable sources of this colouring matter seemed pretty obvious: it may have been derived from rotten timbers; or from soluble portions of animal excreta, or from both. Both occur in the mine, and in contact with a water containing so active an alkali as carbonate of soda, some of them would be carried into solution.

The fact, that practically all these coloured deposits occur in the immediate vicinity of the shaft, where there is always much timber, and trickling alkaline water, at once suggested a ligneous origin for this colour.

A great deal of work was performed to prove this point, though less would have sufficed, had it not been for the other obvious alternative. The evidence for the influence of excrementitious matter was slight and therefore inconclusive; the pre-

sence of small quantities of ammoniacal compounds and traces of phosphate of lime being the only indications. Moreover, these were not present in all the samples that were operated on. Attention was therefore mainly devoted to confirming the woody origin.

There are a great number of definite and indefinite chemical bodies existing in wood: some exceedingly complex; and to isolate and identify them all would occupy far more time than can be spared in a busy laboratory, and it would, besides, be quite unnecessary.

Cellulose is a substance that is derived entirely from vegetable matter. It is a product of the so-called metabolism of living plant tissues, so that, if we meet with a substance in an alkaline water, which after isolation, responds to the generic tests for celluloses, we may reasonably conclude that that water has been in contact with woody matter in some stage of its travels; and if, further, we can isolate the same kind of substance from the actual deposit, which we know to be derived from the water, the inference is again perfectly logical that some, at any rate, of this organic matter has been acquired from the same source.

Not to unduly enlarge this report, I may state as a result of many carefully con-

ducted experiments and tests. I was able to isolate from both the water and deposits, an organic substance which exhibited all the characteristics of a cellulose material.

This result was further confirmed in another way. Some of the decayed timber, which was brought from the mine, was digested with water containing carbonate of soda (N 20), thus imitating as far as we could the conditions we imagined to have occurred in the mine. When the organic matter derived from the timber by this means was isolated from the water and tested, precisely the same results were obtained for cellulose material as in the original samples.

We may now, therefore, state unequivocally that the unusual colour of all these deposits is derived from decaying timber after contact with an alkaline water.

As a final proof that these alkaline waters do come in contact with timber, the slight muddy deposit that was obtained from one of the samples of alkaline water that was collected as it trickled down the walls of the shaft, was examined by means of the microscope. Every portion inspected revealed the presence of many tiny particles of organised structure, such as "cells with bordered pits" and fragments of medullary rays so characteristic of Coniferous or Pine wood, and of Pine wood only, as used in the shaft timbering.

At the close of the lecture, Dr. Fred E. Wright, of the Carnegie Institution of Washington, U.S.A., contributed some remarks and indicated the wide interest and importance of the observations made by Mr. Parry.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

(SECTION A.—MATHEMATICS AND PHYSICS.)

THE THEORY OF NUMBERS.

ADDRESS BY PROFESSOR G. H. HARDY,
M.A., F.R.S., PRESIDENT OF THE SECTION.

(Continued from Page 247.)

It seems to me, then, that we must regard Mersenne's assertion as exploded; and for my part it interests me no longer. If he is wrong about 89 and 107, I do not care greatly whether he is wrong about 137 as well or not, and I should regard the computations necessary to decide as very largely wasted. There are so many much more profitable calculations which a computer could undertake.

I hope that you will not infer that I regard the problem of perfect numbers as uninteresting in itself; that would be very far from the truth. There are at least two intensely interesting problems. The first is the old problem, which so many mathematicians have failed to solve, whether a perfect number can be odd. The second is whether the number of perfect numbers is infinite or not. If we assume that all perfect numbers are infinite, we can state this problem in a still more arresting form. *Are there infinitely many primes of the form $2^n - 1$?* I find it hard to imagine a problem more fascinating or more terribly difficult than that. It is plain, though, that this is a question which computation can never decide, and it is very unlikely that it can ever give us any data of serious value. And the problem itself really belongs to a different chapter of the theory, to which I should like next to direct your attention.

4. *Are there infinitely many primes of the form $n^2 + 1$?* Let me first remind you of some well-known facts in regard to the distribution of primes.

There are infinitely many primes; their density decreases as the numbers increase, and tends to zero when the numbers tend to infinity. More accurately, the number of primes less than x is, to a first approximation,

$$\frac{x}{\log x}$$

The chance that a large number n , selected at random, should be prime is, we may say, about $\frac{1}{\log n}$. Still more precisely, the "logarithm-integral"

$$\text{Li } x = \int_2^x \frac{dt}{\log t}$$

gives a very good approximation to the number of primes. This number differs from $\text{Li } x$ by a function of x which oscillates continually, as Mr. Littlewood, in defiance of all empirical evidence to the contrary, has shown, between positive and negative values, and is sometimes large, of the order of magnitude $\sqrt{x}$ or thereabouts, but always small in comparison with the logarithm-integral itself.

Except for one lacuna, which I must pass over in silence now, this problem of the general distribution of primes, the first and central problem of the theory, is in all essentials solved. But a variety of most exciting problems remain as to the distribution of primes among numbers of special forms. The first and simplest of these is

that of the arithmetical progressions: *How are the primes distributed among all possible arithmetical progressions $an+b$?* We may leave out of account the case in which a and b have a common factor; this case is trivial, since $an+b$ is then obviously not prime.

The first step towards a solution was made by Dirichlet, who proved for the first time, in 1837, that any such arithmetical progression contains an infinity of primes. It has since been shown that the primes are, to a first approximation at any rate, distributed evenly among all the arithmetical progressions. When we pursue the analysis further differences appear; there are on the average, for example, more primes $4n+3$ than primes $4n+1$, though it is not true, as the evidence of statistics has led some mathematicians to conclude too hastily, that there is always an excess to whatever point the enumeration is carried.

The problem of the arithmetical progressions, then, may also be regarded as solved; and the same is true of the problem of the primes of a given quadratic form, say $am^2+2bmn+cn^2$, homogeneous in the two variables m and n . To take, for instance, the simplest and most striking case, there is the natural and obvious number of primes m^2+n^2 . A prime is of this form, as I have mentioned already, if and only if it is of the form $4k+1$. The quadratic problem reduces here to a particular case of the problem of the arithmetical progression.

When we pass to cubic forms, or forms of higher degree, we come to the region of the unknown. This, however, is not the field of inquiry which I wish now to commend to your attention. The quadratic forms of which I have spoken are forms in two independent variables m and n ; the form n^2+1 of my question is a non-homogeneous form in a single variable n , the simplest case of the general form $an^2+2bn+c$. It is clear that one may ask the same question for forms of any degree: Are there, for example, infinitely many primes n^3+2 or n^3+1 ? I do not choose n^3+1 , naturally, because of the obvious factor $n+1$.

This problem is one in which computation can still play an important part. You will remember that I stated the same problem for perfect numbers. There a computer is helpless. For the numbers 2^n-1 , which dominate the theory, increase with quite unmanageable rapidity, and the data collected by the computers appear, so far

as one can judge, to be almost devoid of value. Here the data are ample, and, though the question is still unanswered, there is really strong statistical evidence for supposing a particular answer to be true. It seems that the answer is affirmative, and that there is a definite approximate formula for the number of primes in question. This formula is

$$\frac{1}{2} \text{Li } x \times (1 + \frac{1}{3})(1 - \frac{1}{5})(1 + \frac{1}{7})(1 - \frac{1}{11}) \dots,$$

where the product extends over all primes p , and the positive sign is chosen when p is of the form $4n+3$. Dr. A. E. Western has submitted this formula to a most exhaustive numerical check. It so happens that Colonel Cunningham some years ago computed a table of primes n^2+1 up to the value of 15,000 of n , a limit altogether beyond the range of the standard factor tables, and Cunningham's table has made practicable an unusually comprehensive test. The actual number of primes is 1,199, while the number predicted is 1,219. The error, less than 1 in 50, is much less than one could reasonably expect. The formula stands its test triumphantly, but I should be deluding you if I pretended to see any immediate prospect of an accurate proof.

5. The last problem I shall state to you is this: *Are there infinitely many prime-pairs $p, p+2$?* One may put the problem more generally: *Does any group of primes, with assigned and possible differences, recur indefinitely, and what is the law of its recurrence?*

I must first explain what I mean by a "possible" group of primes. It is possible that p and $p+2$ should both be prime, like 3, 5, or 101, 103. It is not possible (unless p is 3) that $p, p+2$ and $p+4$ should all be prime, for one of them must be a multiple of 3: but $p, p+2, p+6$ or $p, p+4, p+6$ are possible triplets of primes. Similarly

$p, p+2, p+6, p+8, p+12$ can all be prime, so far as any elementary test of divisibility shows, and in fact 5, 7, 11, 13 and 17 satisfy the conditions. It is easy to define precisely what we understand by a "possible" group. We mean a group whose differences, like 0, 2, 6, have at least one missing residue to every possible modulus. The "impossible" group 0, 2, 4 does not satisfy the condition, for the remainders after division by 3 are 0, 2, 1, a complete set of residues to modulus 3.

There is no difficulty in specifying possible groups of any length we please.

We define in this manner, then, a "possible" group of primes, and we put the questions: Do all possible groups of primes actually occur, do they recur indefinitely often, and how often on the average do they recur? And here again it would seem that the answers are affirmative, that all possible groups occur, and continue to occur for ever, and with a frequency whose law can be assigned. The order of magnitude of the number of prime-pairs, $p, p+2$, or $p, p+4$, or $p, p+6$, both of whose members are less than a large number x , is, it appears,

$$\frac{x}{(\log x)^2}$$

The order of magnitude of the corresponding number of triplets, of any possible type, is

$$\frac{x}{(\log x)^3}$$

and so on generally. Further, we can assign the relative frequencies of pairs or triplets of different types; there are, for example, about twice as many pairs whose difference is 6 as pairs whose difference is 2. All these results have been tested by actual enumeration from the factor tables of the first million numbers; and a physicist would probably regard them as proved, though we, of course, know very well that they are not.

There is a great deal of mathematics the purport of which is quite impossible for any amateur to grasp, and which, however beautiful and important it may be, must always remain the possession of a narrow circle of experts. It is the peculiarity of the theory of numbers that much of it could be published broadcast, and would win new readers for the *Daily Mail*. The positive integers do not lie, like the logical foundations of mathematics, in the hardly visible distance, nor in the uncomfortably tangled foreground, like the immediate data of the physical world, but at a decent middle distance, where the outlines are clear and yet some element of mystery remains. There is no one so blind that he does not see them, and no one so sharp-sighted that his vision does not fail; they stand there a continual and inevitable challenge to the curiosity of every healthy mind. I have merely directed your attention for a moment to a few of the immediately conspicuous features of the landscape, in the hope that I might sharpen

your curiosity a little, and that some of you perhaps might feel tempted to walk a little nearer and take a rather closer view.

VITAMINS—ACCESSORY FOOD FACTORS.

WHAT ARE THEY?

Dr. F. W. Alexander, Medical Officer of Health for the Borough of Poplar, has issued a Special Report on the above subject, and this has been ordered to be printed by the Maternity and Child Welfare Committee.

The following extracts are taken from this valuable report.

PART I.

"Recent research has shown that the requirements of the human organism as regards diet cannot be met entirely by an adequate supply of protein fat, carbohydrate, inorganic salts and water. It has therefore modified the common belief of ten or more years ago, when the attention of physiologists was focussed upon the Calorie, or energy value of the diet. It is now established that, in addition to these necessary constituents, certain unidentified principles known as accessory food factors or "vitamines," must also be present in order to maintain health and prevent the occurrence of "deficiency diseases." These substances have not so far been isolated, little is known of their chemical or physical properties, and at the present time their presence can only be detected by experiments with animals."—(Extract from Memorandum issued by the British Committee on Accessory Food Factors, June, 1919.)

Vitamins are constituents of food, the chemical structure of which is not yet known, which in very minute quantities exert a far-reaching influence over the body. They exist in only very minute quantities.

Vitamins are not a medicine, but a necessary constituent of food, and are required by all forms of animal life, birds, animals, children and men. Plants require Vitamins called Auximones.

Some liken Vitamins to enzymes as being in the nature of Catalysts.

Vitamins evidently exert an influence quite out of proportion to the quantity that is present. It has been suggested that they are not exactly food, but "produce a

harmonious interaction between materials in the food and their host." They are catalysts or hormones or accessory factors.

The Vitamins appear to be concerned intimately in nutrition, and for this reason may be called accessory growth substances. Their absence from the dietaries is associated with the production of what have been termed deficiency diseases, such as rickets in children, scurvy, beri-beri, polyneuritis, and a certain sloughing and ulceration of the cornea of the eye in advanced conditions of starvation or malnutrition.

It has been stated that disease in many, if not in most, cases is due to the lack of proper defensive elements (Vitamins) in the body rather than to the presence of an invading germ.

Animals must get all their food from plants, for the animal body cannot produce within itself the substances needed to support life. Where one animal preys upon another it is simply taking from the other animal what that animal has previously collected from the plant world.

PART II.

Kinds of Vitamins or Accessory Food Factors.

The word "Vitamine" was coined by Casimir Funk, a Pole. The first part of the word indicates its relation to the life process (Vita—life); the second to its chemical nature (Amine—a substance which may be derived from ammonia, etc.). The word Vitamine has crept into general use and is now spelled "Vitamin," the terminal "e" having been dropped as it implied that the substances had known chemical constitution, which is at present not justified.

The accessory food factors at present recognised are three in number:—

(1) Fat-soluble "A" growth factor or antirachitic factor called "Vitamin A."

(2) Antineuritic or antiberi-beri factor identified with the water-soluble "B" growth factor of the American investigators, called "Vitamin B."

(3) Water-soluble antiscorbutic Vitamin, called "Vitamin C."

It is thought there may be a fourth Vitamin, a fat-soluble "D."

When more Vitamins are taken into the body than are needed, the excess is simply burned as an excess of proteins, for other uses in the body; consequently, they are harmless.

The body is able to store a reserve of Vitamin A. A portion of Vitamin B is needed for the digestive processes. Children during growth period are more immediately dependent upon Vitamins than adults, and suffer most under famine or war conditions when the food supply is curtailed.

The A Vitamin is a constituent of all cells and is necessary for the promotion of growth in the young as well as for the maintenance of health in adults. Animals can be cured of rickets by adding to their diet antirachitic (fat-soluble A) Vitamins, e.g., butter fat, cod-liver oil or extracts of green vegetables. Vitamin A is present in animal oils and fats except lard, and absent in vegetable oils and fats.

The fat-soluble A Vitamin is the only one which seems to have some reserve store in the body. If it is absent from their food young animals will continue to grow for a short time, and nursing mothers will continue supplying it to their infants.

It is stated that liability to tuberculosis is greatly increased by the absence of Vitamin A.

The Hoover Commission found that wherever people lacked butter and milk containing Vitamin A, tuberculosis became prevalent.

The absence of Vitamin A from food gives rise to an eye disease called Xerophthalmia or Keratomalacia, and to a greatly lowered state of health.

Vitamin B is a constituent of all cells, and is necessary for the maintenance of growth; its absence from the food is an essential cause of Beri-beri.

The chief source of B-Vitamin in our food is the seeds of cereals and other plants, but the factor is removed from cereal seeds in the process of milling. Sugar, sago, and other farinaceous products are lacking in B-factor, meat and fish are poor, offal and eggs in comparison rich. Vegetables and milk contain small amounts. The quantity in these foodstuffs is scarcely sufficient to balance the large carbohydrate consumption of white flour in our diet, unless eggs, fruits and vegetables are eaten in great quantities. The products richest in B-Vitamin are the germs of cereals and yeast. Germ as such is not consumed by humans (except in wholemeal bread), and the yeast used in baking bread is not sufficient. Yeast contains B-Vitamin in great concentration, and palatable preparations made therefrom

can compensate for the lack of B-Vitamin in other foods. No ill effects have been ascribed to too great a consumption of foods rich in B-Vitamin, and it is likely that certain cases of vague ill-health would be improved by the consumption of additional quantities of B-Vitamin." *Lancet*, 10th Dec., 1921. Page 1,228.

Vitamin B is widely distributed throughout natural foodstuffs. Its richest sources are the germs of seeds, eggs, yeast, wheat and rice, bran, peas, beans, lentils and cellular organs (such as liver, brain, sweetbreads, fish-roe, kidney and hard muscle). Nuts are comparatively rich in it; cows' milk is less so. Meat (beef and mutton) contain it in comparatively small amounts, and the flesh of fish is poor in it. Vegetables and fruit contain it in larger amounts than was formerly supposed. It is also richly abundant in yeast and yeast extracts, *e.g.*, yeast extract and autolysed.

THE THERM.

REPORT OF THE FUEL RESEARCH BOARD ON GAS STANDARDS.*

Preface.

In re-issuing the reports of the Fuel Research Board on Gas Standards, the Department of Scientific and Industrial Research desire to assist the general public to understand the importance of this subject from the points of view of the producers and consumers of gas, and its bearing on the conservation of the national coal resources.

Twenty-five years ago the gas used by householders for lighting purposes was, in the main, burnt directly in the old-fashioned burner. The value of the gas as supplied to the householder then depended on its illuminating quality when so burnt. With the introduction of the incandescent mantle, these conditions were entirely changed. In the incandescent burner the gas is mixed with air and burns with a bluish flame. Its value for lighting purposes depends on the heat of this flame, which is used to make the mantle white hot. As a result, the value of the gas for lighting purposes supplied to the householder to-day depends on its heating quality and not on its illuminating quality when burnt by itself. Simultaneously with this change, the improvement in the ordinary gas fire led to an increasing use of gas in the house in place of coal. In the gas fire,

as in the incandescent burner, the gas is mixed with air and burns with a bluish flame. Its value depends on the heat which it supplies to the asbestos and fire-brick of which the gas fire is composed.

During the war the extraction of valuable products for the manufacture of explosives, the scarcity of coal and its poor quality led to a marked fall in the heating quality of the gas supplied to the consumer. The gas supplied was a mixture which contained a high proportion of nitrogen and other incombustible constituents. These incombustible constituents, technically called "inerts," merely diluted the gas, and were of no value to the householder for heating purposes.

The problem to be faced by the gas-supplying industry and the country after the war was therefore to answer the question—How can the gas regulations be amended so as to enable the Gas Undertakings to make the most economical use of our coal in the supply of gas to the public, and at the same time, how can it be ensured that the consumer shall pay for his gas at a price depending solely on its heating qualities? This was the problem which was referred to the Fuel Research Board by the Board of Trade.

The Fuel Research Board reached the conclusion that in the interests of the economy of our fuel resources, the Gas Undertakings ought to be allowed more liberty in determining the composition of the gas they supplied, since local conditions varied in different parts of the country, and since there was varying local demand for the different by-products which could be obtained by different methods of manufacture. They also found the existing checks on the heating quality of the gas supplied through the mains to be inadequate, and the tests required by the then existing Acts to be insufficient to secure that the undertakings supplied gas of a uniform and stated heating quality. Further, it was clear that the interest of the consumer, while it required the encouragement of the most economical methods of producing gas, could only be secured if he were charged for the heat which the gas supplied to him would provide when burnt in properly adjusted appliances.

The solution recommended by the Fuel Research Board took account of all these considerations. The Gas Undertakings were to be required to declare the calorific or heating value of the gas they intended to

supply, and to keep to this quality within reasonable limits. The quality was to be recorded continuously by a recording calorimeter, and the records to be made available for inspection by the consumer. This method was to supersede the periodic test by the local gas examiners, of which notice was usually given to the Gas Undertakings. *At the same time whenever the Gas Undertakings altered the heating value of the gas they supplied they were to adjust, free of charge, the burners fitted in the households of their consumers.*

Secondly, the Board recommended a method by which the charge to the consumer should be based solely on the heating quality of the gas. If a Gas Undertaking supplied a gas of low heating quality, they would only be able to charge for the number of therms in each thousand cubic feet.

Thirdly, after the interests of the consumer had been protected in these two ways, the Gas Undertakings were to be given greater freedom in settling the composition of the gas they would supply, thus allowing greater variation in the methods of manufacture.

This reasonable liberty would tend to secure a minimum price of gas to the consumer and help to conserve the national coal resources.

As the result of a series of conferences, these principles received the general support of representatives both of the gas-making industry and of the consumers, and a scheme based upon the recommendations of the Board found legislative sanction in the Gas Regulation Act of 1920.

Department of Scientific and Industrial Research.

16, Old Queen St., Westminster,
London, S.W.1.

October, 1922.

* Copies of the Review are obtainable from H.M. Stationery Office, Imperial House, Kingsway, W.C., or through any Bookseller; post free 4d.

THE PREPARATION & PROPERTIES OF ORGANIC STANNO- AND STANNICHLORIDES.

PART V.—THE SALTS OF CERTAIN SPECIAL BASES.

By J. G. F. Druce, M.Sc., A.I.C.

In continuation of previous work (compare *The Chemical News*, 1919, CXVII., 1 and 87, *ibid.*, CXIX., 73, *ibid.*, 1922,

CXXIV., 310), the stannichlorides of hydroxylamine, 5-amino-quinoline, 6-amino-quinoline, and isoquinoline have been made. The stannochlorides of 5-amino-quinoline and 5-amino-quinoline have also been prepared.

There has been considerable discussion regarding the constitution of hydroxylamine. This base is now generally recognised to exist in the tautomeric forms:—

I. II.

NH_2OH and NH_3O .

Haber (*Ber.*, 1896, XXIX, 2444) has suggested that the hydroxyl structure I., accurately represents the substance in its salts. This was disputed by Ebler and Schott (*J. prakt. Chem.*, 1908, [2], LXXVIII., 289), but recently A. Michael (*Journ. Amer. Chem. Soc.*, 1921, XLIII., 315) has re-investigated this problem, and concludes that all the properties of the substance point towards its formula being NH_2OH . The existence of the stannichloride supports the view that in salts, at least, this formula accurately represents its structure.

It was thought that the salts of amino-quinoline and amino-quinoline might be of interest since these bases are simultaneously primary and tertiary bases. Their salts have, however, shown no special characteristics.

The quinoline used in the preparation of the 5-nitro-quinoline which was used for making the 5-amino-quinoline double haloids, was prepared by the modification of Skraup's synthesis described by E. de Barry Barnett (*The Chemical News*, 1920, CXXI., 205). His method was found to be even more convenient than the modification previously described (Druce, *The Chemical News*, 1919, CXIX., 271).

The 6-nitro-quinoline required in the preparation of the 6-amino-quinoline salts was obtained by following the method described by Hamer (*Journ. Chem. Soc.*, 1921, CXIX., 1435) in a paper entitled "A Comparison of some Isomeric iso-Cyanines."

EXPERIMENTAL.

Hydroxylamine Stannichloride (NH_2OH) $_2$. H_2 . SnCl_4

Hydroxylamine hydrochloride (2 grams) and 5.3 grams of crystalline stannic chloride, $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$, were dissolved together in 50 cc. of dilute hydrochloric acid. The concentrated solution gave a white micro-crystalline deposit on standing. This was filtered off, drained, and dried on a porous tile.

The stannichloride dissolved readily in cold water and the solution required heating before hydrolysis became apparent by the separation of a flocculent gelatinous precipitate. Sodium hydrate solution did not evolve ammonia gas from the solution.

Except hot alcohol, organic solvents did not dissolve hydroxyamine stannichloride. It did not melt on heating up to 300° , but appeared to undergo a shrinkage at about 270° .

On analysis:

0.8695 grm. gave 0.3118 grm. SnO_2 ;

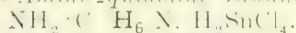
Sn = 30.3 per cent.

0.3330 grm. gave 0.7220 grm. AgCl ;

Cl = 53.6 per cent.

$(\text{NH}_2\text{OH})_2 \cdot \text{H}_2\text{SnCl}_6$ requires Sn = 29.73 and Cl = 53.25 per cent.

5-Amino-quinoline Stannochloride



This salt has been obtained by warming 4 grams of 5-nitro-quinoline with 10 grams of tin and 100 cc. of concentrated hydrochloric acid. The yellow colour due to the nitro-compound disappeared, and on cooling, crystals separated. These were filtered off, re-dissolved in hot dilute hydrochloric acid, filtered, and the solution allowed to crystallise. The clusters of very pale yellow prisms which separated were filtered off, drained and dried on a porous tile in a desiccator over calcium chloride.

The stannochloride melted at 160° to a clear yellow liquid. It did not dissolve in water to a clear solution, and the cloudiness increased on warming.

On analysis:—

0.5983 grm. gave 0.2293 grm. SnO_2 ;

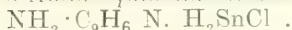
Sn = 30.2 per cent.

0.2339 grm. gave 0.3322 grm. AgCl ;

Cl = 35.1 per cent.

$\text{NH}_2 \cdot \text{C}_9\text{H}_6\text{N} \cdot \text{H}_2\text{SnCl}_4$ requires Sn = 29.8 and Cl = 35.42 per cent.

5-Amino-quinoline Stannichloride



Three grams of 5-Nitro-quinoline were warmed with 12 grams of stannous chloride and 80 cc. of concentrated hydrochloric acid diluted with 50 cc. of water. When the reduction was complete, the resulting solution was cooled and deposited orange crystals. These were recrystallised from hot dilute hydrochloric acid.

5-Amino-quinoline stannichloride dissolved in water, but the solution became cloudy on warming. The solution was strongly acid; it gave no precipitate with mercuric chloride, but yellow stannic sulphide was obtained by passing in hydrogen sulphide.

Hot methyl- and ethyl alcohols dissolved

the salt, but it was insoluble in other organic solvents. When heated it melted to a pale brown liquid at 242° .

On analysis:—

0.4965 grm. gave 0.1210 grm. SnO_2 ;

Sn = 24.25 per cent.

0.4691 grm. gave 0.8120 grm. AgCl ;

Cl = 42.8 per cent.

$\text{NH}_2 \cdot \text{C}_9\text{H}_6\text{N} \cdot \text{H}_2\text{SnCl}_6$ requires Sn = 24.43

and Cl = 43.5 per cent.

6-Amino-quinaldine Stannochloride



6-Nitro-quinaldine was obtained in very satisfactory yield (about 85 per cent.), from p-nitroaniline, hydrochloric acid, and paraldehyde by the method described by Hamer (*J.C.S.*, 1921, CXIX., 1435). It was recrystallised from alcohol and two grams were treated with four grams of tin and 60 cc. of hydrochloric acid diluted with an equal volume of water. A clear colourless solution resulted after warming for an hour. When cold the solution deposited feathery crystals on stirring. These were filtered with some difficulty, a felted mass resulting which was deliquescent. This was recrystallised from dilute hydrochloric acid, and the crystals were washed with alcohol and dried on a porous tile in a desiccator over solid sodium hydroxide.

6-amino-quinaldine stannochloride dissolved very readily in cold water. The solution remained clear until heated. With mercuric chloride solution it gave a white precipitate which turned grey, indicating that the salt contained stannous tin. The precipitate obtained on adding hydrogen sulphide water to a solution of the salt was dark brown.

The salt dissolved in boiling glacial acetic acid, and also slightly in boiling ethyl alcohol with amyl alcohol a deep red colour was developed on heating. It was insoluble in benzene, acetone, chloroform and ether. When heated it began to decompose at about 180° .

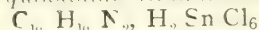
On analysis:—

0.4287 grm. gave 0.1139 grm. SnO_2 ;

Sn = 20.88 per cent.

$\text{C}_{10}\text{H}_{10}\text{N}_2 \cdot \text{H}_2\text{SnCl}_4$ requires Sn = 20.55 p.c.

6-Amino-quinaldine Stannichloride



6-Nitro-quinaldine (two grams) was treated with 7.5 gram Stannous chloride and 50 cc. of concentrated hydrochloric acid diluted with twice this volume of water. The mixture was heated until it became a clear and colourless solution, which deposited colourless nacreous platelets on cooling.

This salt dissolved readily in cold water

to a clear solution which gradually deposited a white flocculent precipitate of hydrated stannic oxide. This precipitate appeared very readily on boiling the solution. Hot alcohols dissolved the salt, but it was insoluble in other organic solvents. The amyl alcohol solution was a deep red colour.

It melted with decomposition on heating to 224°-228°.

On analysis:—

0.7025 grm. gave 0.1703 grm. SnO_2 ;

Sn = 19.1 per cent.

0.2170 grm. gave 0.2818 grm. AgCl ;

Cl = 32.1 per cent.

$\text{C}_{10}\text{H}_{10}\text{N}_2 \cdot \text{H}_2\text{SnCl}_6$

requires Sn = 18.30 and Cl = 32.78 per cent.

Isoquinoline Stannichloride

$(\text{C}_9\text{H}_7\text{N})_2 \cdot \text{H}_2\text{SnCl}_6$.

This salt was prepared by adding 5.2 grams of the base to a solution of 5.25 grams of anhydrous stannic chloride in 200 cc. of dilute hydrochloric acid. The mixture was boiled for a few minutes and the very pale pink solution so obtained was then cooled and deposited a mass of fine, almost colourless, prismatic crystals.

These were filtered at the pump, drained and dried. They were recrystallised from hot dilute hydrochloric acid.

On heating the crystals began to darken at about 240° and melted at 265°. At higher temperatures a white sublimate was formed and this, like many similarly obtained from other stannichlorides, contained tin.

Isoquinoline stannichloride was somewhat soluble in cold water, more readily so in hot water, but in this case hydrolysis took place, the solution being strongly acid, emitting the odour of the free base and depositing a flocculent precipitate. The salt dissolved slightly in methyl and ethyl alcohols on warming, and in glacial acetic acid and hot nitrobenzene, but other organic solvents did not dissolve it.

On analysis:—

0.5147 grm. gave 0.1302 grm. SnO_2 ;

Sn = 19.82 per cent.

0.1822 grm. gave 0.2583 grm. AgCl ;

Cl = 35.11 per cent.

$(\text{C}_9\text{H}_7\text{N})_2 \cdot \text{H}_2\text{SnCl}_6$ requires Sn = 20.05 and Cl = 35.95 per cent.

[CONTRIBUTION FROM THE DEPARTMENT OF THE UNIVERSITY OF NORTH CAROLINA.]
ZIRCONIUM FERROCYANIDE AND FERRICYANIDE.

By F. P. VENABLE AND E. O. MOEHLMANN.¹
(From the *Journal of the American Chemical Society*.)

There are only casual references in the literature to the possible existence of zir-

conium ferrocyanide and ferricyanide, and these concern mainly their use as qualitative tests.

Some of the older texts state that potassium ferrocyanide gives a yellow precipitate in neutral solutions of zirconium salts. De Boisbaudran² stated that this precipitate was given also in acid solutions even when very dilute. Of course, on account of hydrolysis a neutral solution would remain such only for a very brief time. Before this Hornberger³ had gone into the matter more in detail and reported the precipitate as yellow-white and insoluble in excess of the precipitant. When precipitated hot the yellow colour became yellow-blue and the odour of hydrogen cyanide was detected. When dried it was blue with a touch of green. It was insoluble in water but soluble in acids with evolution of hydrogen cyanide. For analysis he dissolved the precipitate in sulphuric acid diluted with 25 per cent. of water. From his results he calculated the formula, $3\text{Zr}(\text{CN})_2 \cdot 2\text{Fe}(\text{CN})_6$, which he compared with Turnbull's Blue, $3\text{Fe}(\text{CN})_2 \cdot 2\text{Fe}(\text{CN})_6$. This, as he remarked, involved the assumption of bivalent zirconium.

Zirconium Ferrocyanide.—In the following experiments 0.1 M solutions of zirconium oxychloride, $\text{ZrOCl}_2 \cdot 8\text{H}_2\text{O}$, and potassium ferrocyanide were prepared. The first was freshly prepared. The precipitate formed on addition of potassium ferrocyanide was white and flocculent or curdy. It was insoluble in excess of either reagent and unchanged in colour. On prolonged exposure or drying in the air the colour changed from yellow to blue and bluish-green. The precipitate remains white for some time when covered with cold, boiled water. It cannot be filtered to approximate dryness without changing colour. The zirconyl chloride used was very nearly free from iron. The changes in colour are doubtless due to decomposition and freeing of iron from partial decomposition of the ferrocyanide.

The fresh precipitate is soluble in conc. sulphuric acid. Decomposition, however, is indicated by changes of colour. This is avoided by making a smooth paste of the ferrocyanide with water, then dissolving

¹ From a thesis presented in partial fulfilment of the requirements for the degree of Bachelor of Science.

² De Boisbaudran, *Compt. rend.*, 94, 6125 (1882).

³ Hornberger, *Ann.*, 181, 232 (1876).

in acid and diluting to about $\frac{1}{4}$ strength. Acid of this strength directly applied fails to effect solution. When ammonium hydroxide is added to complete precipitation, but in as slight excess as possible, a precipitate of zirconium hydroxide $\text{Zr}(\text{OH})_4$ is obtained and the ammonium ferrocyanide and sulphate are removed in the filtrate. The precipitate was dried and ignited to the dioxide. The filtrate and washings were combined and titrated by standard potassium permanganate.

Two sets of analyses were performed in duplicate with products from solutions at room temperature, the zirconyl chloride solution being used immediately after preparation. The first contained 0.8 gr. of $\text{ZrOCl}_2 \cdot 8\text{H}_2\text{O}$ and the second 2.0 gr.

Expt. 1 a. $\text{ZrO} = 0.0730$; $\text{Fe}(\text{CN})_6 = 0.0463$; ratio 1.57

b. $\text{ZrO} = 0.0719$; $\text{Fe}(\text{CN})_6 = 0.0466$; ratio 1.54

Expt. 2 a. $\text{ZrO} = 0.2767$; $\text{Fe}(\text{CN})_6 = 0.1987$; ratio 1.39

b. $\text{ZrO} = 0.2779$; $\text{Fe}(\text{CN})_6 = 0.1958$; ratio 1.41

In a third experiment the zirconyl chloride solution was first boiled so as to become thoroughly hydrolysed, and then was cooled.

Expt. 3 a. $\text{ZrO} = 0.1450$; $\text{Fe}(\text{CN})_6 = 0.0424$; ratio 3.42

b. $\text{ZrO} = 0.1436$; $\text{Fe}(\text{CN})_6 = 0.0431$; ratio 3.33

When water is present no normal zirconium salt can be formed; zirconyl salts are found instead, or basic zirconyl salts more or less hydrolysed under the influence of dilution, time and temperature. Taking certain hypothetical salts for purpose of comparison it is seen that $(\text{ZrO})_2\text{Fe}(\text{CN})_6$ has the ratio 1.01; $\text{ZrO}(\text{OH})_2 \cdot (\text{ZrO}_2\text{Fe}(\text{CN})_6)$ 1.51; $3\text{ZrO}(\text{OH})_2 \cdot 4(\text{ZrO}_2\text{Fe}(\text{CN})_6)$ 1.39; $9\text{ZrO}(\text{OH})_2 \cdot 2(\text{ZrO}_2\text{Fe}(\text{CN})_6)$ 3.27. The analytical results show that the hydrolysis proceeded too rapidly under the conditions of the experiments to yield zirconyl ferrocyanide, $(\text{ZrO}_2\text{Fe}(\text{CN})_6)$. Only basic ferrocyanides were obtained corresponding to different stages in the hydrolysis.

Zirconium Ferri-cyanide. - The older texts report that no precipitate is formed when a solution of potassium ferri-cyanide is added to solutions of zirconium salts. Rose,⁴ however, reported such a precipita-

It was found that no precipitate was formed when 0.2 M solutions of zirconyl chloride and potassium ferri-cyanide were mixed, nor were precipitates obtained when more concentrated solutions were used, nor when either salt was added in excess. When such mixtures were slowly evaporated in a desiccator the only crystals formed were those of potassium ferri-cyanide. The rest of the mass was amorphous and varicoloured from green to blue and darkening almost to black. This we interpret as indicating that zirconyl ferri-cyanide, if formed, is too soluble to appear as a precipitate and is easily decomposed. Similar results were obtained when solutions of zirconyl sulphate were used.

The formation of a basic zirconyl ferri-cyanide is much easier, however, and this accounts for the observation of Rose. When dilute solutions of zirconyl chloride are strongly hydrolysed by boiling and potassium ferri-cyanide then added, a bright yellow, flocculent precipitate was obtained which, like the ferrocyanide, changed to green, blue, and almost black on drying.

Two gr. of zirconyl chloride octahydrate was dissolved in 100 cc. of water, the solution boiled for 30 minutes, cooled and precipitated with as little excess of potassium ferri-cyanide as possible. The precipitate was washed by decantation with about 3 litres of water. This was found more easily soluble and in somewhat more dil. sulphuric acid than the ferrocyanide previously described and the solution remained unchanged for some days, in which also it differed from the ferrocyanide. The solution was diluted about 10-fold, sodium hydroxide added in very slight excess, the zirconium hydroxide filtered off, ignited and weighed as the dioxide. The ferri-cyanide radical was determined volumetrically by reduction to ferrocyanide and titration with standard potassium permanganate. In a second set of experiments, 4 gr. of zirconyl chloride octahydrate was used. In both sets the results were checked by using aliquot parts for the analyses

	ZrO	$\text{Fe}(\text{CN})_6$	Ratio
	g.	g.	
I a.	0.1724	0.0255	6.762
b.	0.1726	0.0185	9.326
II a.	0.5276	0.0774	6.815
b.	0.2788	0.0409	6.812
c.	0.2619	0.0383	6.847

The result for ferri-cyanide in Set Ib was rejected as faulty from some error in analysis. Omitting this, therefore, the average

⁴ Rose, *Ann. Phys. Pogg.* 48, 575 (1840).

ratio is 6.809. Calculating this ratio from a hypothetical hydrolysed zirconium ferri-cyanide $m\text{ZrO}(\text{OH})_2 \cdot n(\text{ZrO})_3\text{Fe}(\text{CN})_6$ the ratio at which m and n are both unity equals 2.012; when $m = 10$ and $n = 1$ the ratio is 6.540; when $m = 11$ and $n = 1$ the ratio is 7.043; when $m = 21$ and $n = 2$ the ratio is 6.791. The results indicate a constancy of proportion too great for an indefinite adsorption compound and so the formation of a definite very basic compound in which the acid radical is retained even after repeated washings with water. The most probable formula would be $21\text{ZrO}(\text{OH})_2 \cdot 2(\text{ZrO})_3\text{Fe}(\text{CN})_6$. In this less than 1/10 as much acid is left as is present in the compound representing the first stage of hydrolysis from the normal zirconium ferri-cyanide.

SUMMARY.

1. Precipitates are formed when potassium ferri-cyanide is added to solutions of zirconium salts. These are basic zirconyl ferri-cyanides, unstable in the air, and their composition depends upon the extent of hydrolysis. Thus, a freshly prepared solution of zirconyl chloride gives a substance of the formula, $\text{ZrO}(\text{OH})_2 \cdot (\text{ZrO})_3\text{Fe}(\text{CN})_6$, and one that has been hydrolysed by boiling gives a substance of the formula, $9\text{ZrO}(\text{OH})_2 \cdot 2(\text{ZrO})_3\text{Fe}(\text{CN})_6$.

2. Potassium ferri-cyanide gives no precipitate in freshly prepared solutions of zirconyl chloride. After boiling, the very basic compound $21\text{ZrO}(\text{OH})_2 \cdot 2(\text{ZrO})_3\text{Fe}(\text{CN})_6$ is precipitated.

Chapel Hill, North Carolina.

GENERAL NOTES.

BOARD OF TRADE ANNOUNCEMENT. SAFEGUARDING OF INDUSTRIES ACT—PART I. FINAL DECISION IN REGARD TO GALLIC ACID.

The Board of Trade announce that the Referee, after hearing a complaint under the above Sub-Section that Acid Gallie had been improperly excluded from the lists of articles chargeable with duty under Part I. of the Safeguarding of Industries Act, has given judgment upholding the complaint; and accordingly the lists issued by the Board are amended so as to include the item "Acid Gallie," as from and including the 21st October, 1922.

It may be recalled that Gallie Acid was in the original list as drawn up by the Board of Trade. In consequence, however, of certain observations by the Referee in

regard to the removal of Cream of Tartar, the Board of Trade also deleted Gallie Acid. The effect of the final decision of the Referee, as given above, is to restore Gallie Acid to the list as originally drawn up by the Board.

*Board of Trade,
19th October, 1922.*

DYESTUFFS ADVISORY LICENSING COMMITTEE.

The Board of Trade announce that, following upon the resignations of Sir Harry V. Kilvert, J.P., Mr. G. W. Currie, and Dr. M. O. Forster, F.R.S., F.I.C., from the Dyestuffs Advisory Licensing Committee, which was originally set up in January, 1921, pursuant to passage of the Dyestuffs (Import Regulations) Act, 1920, Sir Thomas Robinson, C.B.E., M.P., has been appointed Chairman, and Mr. R. Waddington, M.P., and Professor G. T. Morgan, F.R.S., F.I.C., members of the Committee.

METALLURGICAL RESEARCH.

Professor Thomas Turner, in his presidential address to the members of the Metallurgical Society of the University of Birmingham, on Wednesday last stated that a large amount of research work was done there last year. It had relation particularly to experiments in steel and non-ferrous metals, and to the properties of refractories and fire-clays. The researches had been of a high character, as was evidenced by the way they had been received by competent authorities. "The Turner Medal" and £10 worth of books was presented to Mr. Harold Wiggin, for his work during the year. This prize was the outcome of an anonymous donation of 500 gs. as an expression of appreciation of the researches made under the direction of Prof. Turner.

MEETINGS OF SOCIETIES.

ROYAL SOCIETY.

List of papers read on Thursday, Nov. 2nd, 1922:—

LORD RAYLEIGH, F.R.S.: *Polarisation of the Light Scattered by Mercury Vapour near the Resonance Periodicity.*

G. P. THOMSON: *The Scattering of Hydrogen Positive Rays and the Existence of a powerful Field of Force in the Hydrogen Molecule.* Communicated by Sir J. J. Thomson, F.R.S.

H. D. SMYTH: *A new Method for studying Ionizing Potentials*. Communicated by Sir E. Rutherford, F.R.S.

I. BACKHURST: *Variation of the Intensity of reflected X-radiation with the Temperature of the Crystal*. Communicated by Sir W. Bragg, F.R.S.

S. DATTA: *The Absorption Spectrum of Potassium Vapour*. Communicated by Prof. A. Fowler, F.R.S.

K. R. RAMANATHAN: *The Molecular Scattering of Light in Vapours and in Liquids and its Relation to the Opalescence observed in the Critical State*. Communicated by Dr. G. T. Walker, F.R.S.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, HELD ON THURSDAY, NOVEMBER 2ND, 1922, AT 8 P.M.

The following papers were read:—

The solubility and volatility of the nitro-benzaldehydes. N. V. SIDGWICK and W. M. DASH.

Investigations on the dependence of rotatory power on chemical constitution. Part XIII. *The spatial configuration of the unbranched aliphatic chain*. R. H. PICKARD, J. KENYON and H. HUNTER.

Investigations on the dependence of rotatory power on chemical constitution. Part XIV. *The normal aliphatic ethers of d- β -octanol*. J. KENYON and R. A. McNICOL.

Investigations on the dependence of rotatory power on chemical constitution. Part XV. *The normal aliphatic ethers of d-methyl benzylcarbinol*. H. PHILLIPS.

Investigations on the dependence of rotatory power on chemical constitution. Part XVI. *A new type of Walden inversion*. H. PHILLIPS.

Investigations on the dependence of rotatory power on chemical constitution. Part XVII. *The di-d- β -octyl esters of the acids of the general formula $(CH_2)_n(COOH)_2$* . L. HALL.

Orientation of the 1:4- and 1:5-dimethylglyoxalines. Mode of fission of 5-aminoglyoxalines. F. L. PYMAN.

Bromo-derivatives of 2-methylglyoxaline. L. LIGHT and F. L. PYMAN.

THE OPTICAL SOCIETY.

The programme of the Optical Society for the current session includes the following lectures, dealing with the evolution and development of optical instruments and apparatus: "The history of the photographic lens," by Dr. R. S. Clay, on 9th

November, 1922; "The birth of cinematography and its antecedents," by Mr. Will Day, on 25th January, 1923; "Surveying and nautical instruments from a historical standpoint," by Dr. L. C. Martin, on 22nd March, 1923; and "Telescopes from a historical standpoint," by Mr. D. Baxandall, A.R.C.Sc., on 24th May, 1923.

The lectures will, in each case, be illustrated by a series of unique instruments of historic interest from various collections.

The meetings will be held at 7.30 p.m. on the dates specified, at the Imperial College of Science and Technology, South Kensington.

NOTICES OF BOOKS.

Filtration, by T. ROLAND WOLLASTON. Pp. X. + 102. London: Sir Isaac Pitman & Sons, Ltd., Parker St., Kingsway, W.C. 1922. Price 2s. 6d.

In this volume of Pitman's Technical Primer Series, Mr. Wollaston has given a concise and clear account of the various industrial methods of filtration. He has collected much information especially useful for those chemists, engineers and others concerned with public health and water supply.

Various systems for the filtration of liquids and gases are described very clearly, and although merely claiming to be an elementary treatise, the book contains much of value to specialists.

It will be found very serviceable by those who can afford little time to consult and wade through large treatises for information on any point in connection with this subject.

The definition of *Permanent Hardness* of water, given on p. 4, is hardly exact, but no other inaccuracy has been noticed during a careful perusal of the book.

Die Methoden zur Herstellung Kolloider Lösungen Anorganischer Stoffe, von Dr. THE SVEDBERG. Pp. XII. + 508 + 3 plates. Dresden and Leipzig: Verlag von Theodor Steinkopff. 1922. Price 13s. 2d. unbound, 14s. 2d. bound.

Dr. Theodor Svedberg's valuable compilation on the methods for preparing substances on the colloidal state has now reached its third edition.

The methods for the preparation of colloidal solutions may be broadly divided into two kinds, Condensation Methods and Dispersion Methods. In the former, the

author includes the methods of reduction, oxidation, hydrolysis and certain special processes.

A very complete bibliography accompanies each section of the various processes and the author has not hesitated to quote extensively, where appropriate, from the original sources.

The most important methods of general application are compactly summarised in the form of tables at the end of each section which is further divided into a general and historical part, and a special or descriptive part.

It is interesting to note that the first edition in 1909 cost 16s. unbound and 18s. bound, whereas the present edition costs in England 14s. 2d. bound.

The book will find its way into most chemical and scientific libraries. Many chemists and physicists will also find it indispensable.

Researches on Cellulose. IV. (1920-1921), by CHARLES F. CROSS and CHARLES DOREE. Pp. X. + 253 + 1 plates. London: Longmans, Green & Co., 39, Paternoster Row, E.C. 1922. Price 15s.

The study of Cellulose is a vast one and covers a very wide field indeed, and the authors of this fourth volume of *Researches on Cellulose* have undertaken a great and useful task in selecting and compressing into 250 pages the really important advances in this field during the last decade.

Their theme is that cellulose must be considered as something more than a molecule represented by a formula. They admire and record the brilliant structural work of pure chemists that has assisted towards the elucidation of some of the problems connected with this body. By closing with 1921 they have been unable to refer to the work of Principal J. C. Irvine in his address to the British Association (which appeared in the *Chemical News*, Sept. 22, p. 165 *et seq.*, of this volume), which has practically settled the constitutional controversy.

They have recorded the important researches on the hydrolytic degradation of cellulose, including Miss Cunningham's "Re-investigation of the Cellulose Dextrose Relationship." The authors point out that it is very easy to alter cellulose in the course of purification, such substances as oxy-cellulose and hydrocellulose being produced. All past technical advances in

the cellulose industries have been the achievements of those who have regarded it as an organised vegetable structure as well as a chemical product. Especially is this noticeable in the manufacture of artificial silk by the "Viscose" process, which may lead to many industrial developments.

The sections on the analysis of woods and on the bacterial resolution of celluloses are noteworthy, since they give the results of new and very original work. Unpublished researches by the authors on ligno-cellulose have also been included. It amplifies their contention that a fractional combination changes the whole mass of the cellulose.

The work on hemi-celluloses and colloidal cellulose properties has received adequate treatment. In the chapter on Physical properties of wool celluloses and their prominence is given to the recent work on the solvent action of aqueous solutions of neutral salts on cellulose, by H. E. Williams.

The slip-plane work of W. Robinson also has very important bearings upon the physical properties of wool celluloses and their industrial applications.

In this volume the authors have adopted the Chemical Society's method of quoting references. The general adoption of this system would be very welcome.

The authors are both very well-known authorities in this branch of organic and applied chemistry. Their book makes no claim of being exhaustive, yet it gives a good and accurate account of the real progress that has been made in this subject.

J.G.F.D.

BOOKS RECEIVED.

The Manufacture of Dyes, by JOHN CANNELL CAIN, D.Sc. Pp. IX. + 274. 1922. Messrs. McMillan & Co., Ltd., St. Martins Street, W. 12s. 6d.

Chemical Engineering Catalog. COMMITTEE OF THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Pp. 1,187. Seventh Annual Edition. 1922. The Chemical Catalog Co. Inc., 19, East 24th Street, New York. 10 Dollars.

PAMPHLETS.

SCIENCE BY DEFINITION SERIES.

By F. H. Loring.

- (1) *Definition of Relativity*. Pp. 16.
- (2) *Definition of the Ether*. Pp. 16.
- (3) *Definition of Equivalence*. Pp. 16.
- (4) *Definition of Isotopes*. Pp. 20.

Published by H. O. Lloyd & Co., Ltd.,

327. Upper St., N.I. at 1s. each.

The object of this series is to give in concise form, definitions of current scientific terms, words or ideas, so that the reader may acquire a better understanding of their purport, and thereby be able to dip deeper into the literature which is growing so rapidly owing to the world-wide activities in pure science.

In forming these "definitions" the author has drawn from the works of authors of recognised authority, so that complete originality is not claimed.

Whilst interest in Relativity continues unabated, those desirous of obtaining a clear conception of the fundamental principles may, with advantage, study No. 1 of Mr. Loring's series. This applies to students and to others whose chief interests have led them from the mathematical sciences.

Indeed, these pamphlets might form a convenient introduction to the study of Relativity.

No. 2 has appeared at an opportune moment. At a time when wireless broadcasting is so extensively in operation, a consideration of the medium which is supposed to act as a carrier of the wave energy becomes of great general interest.

The subject is admittedly a difficult one, because the ether gives no direct clue to its existence, *i.e.*, the strongest argument in favour of an all-pervading ether is based upon analogy.

The 20 pages on explanation of the existence of "Isotopes" are very good. The very latest information upon this important subject is included. The author has incorporated some of the material from his communications to *The Chemical News*, and also refers to the valuable results obtained by well-known experimentalists in this field.

Mr. Loring states that more pamphlets of this kind are in preparation, and their publication is awaited with interest.

Much confusion in the meaning of terms used differently by, say chemists and physicists, has arisen, and the series should serve a useful purpose in enabling general readers to obtain accurate impressions of the various phrases and terms now coming into scientific use.

The Evolution of Atoms and Isotopes, by W. D. VERSCHOYLE, published by J. J. Keliher & Co., Ltd., Craven House, Kingsway, W.C.2, at 1s. 9d.

The author has divided his booklet of 40 pages into two parts.

He commences with a glossary of the new terms used in "Sub-Atomic Chemistry." A complete list of the known and suspected elements is given with the symbols and latest Atomic Weights.

The subject is discussed with the aid of tables and diagrams illustrating the author's interesting views on the evolution of the atoms and isotopes. He has drawn his conclusions from the experimental results and conclusions of the distinguished researchers in this branch of science.

His views and scheme of evolution will probably encounter opposition, and will not be readily accepted, but is certainly worthy of the careful consideration of all who are interested in this subject.



This list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 26967—Coke & Gas Ovens, Ltd.—Method of producing white commercial pure ammonium chloride. Oct. 5.
- 27083—Dreyfus, H.—Manufacture of products from alkali compounds. Oct. 6.
- 27107—Holzverkohlungs Industrie Akt-Ges.—Process for chlorination of methane. Oct. 6.
- 26883—Hovey, E. L.—Nitrate of lime. Oct. 5.
- 26739—Hovey, E.—Process for production of hydrogen sulphide. Oct. 3.
- 26722—Jackson, W. J.—Manufacture of hydrogen sulphide.

Specifications Published this Week.

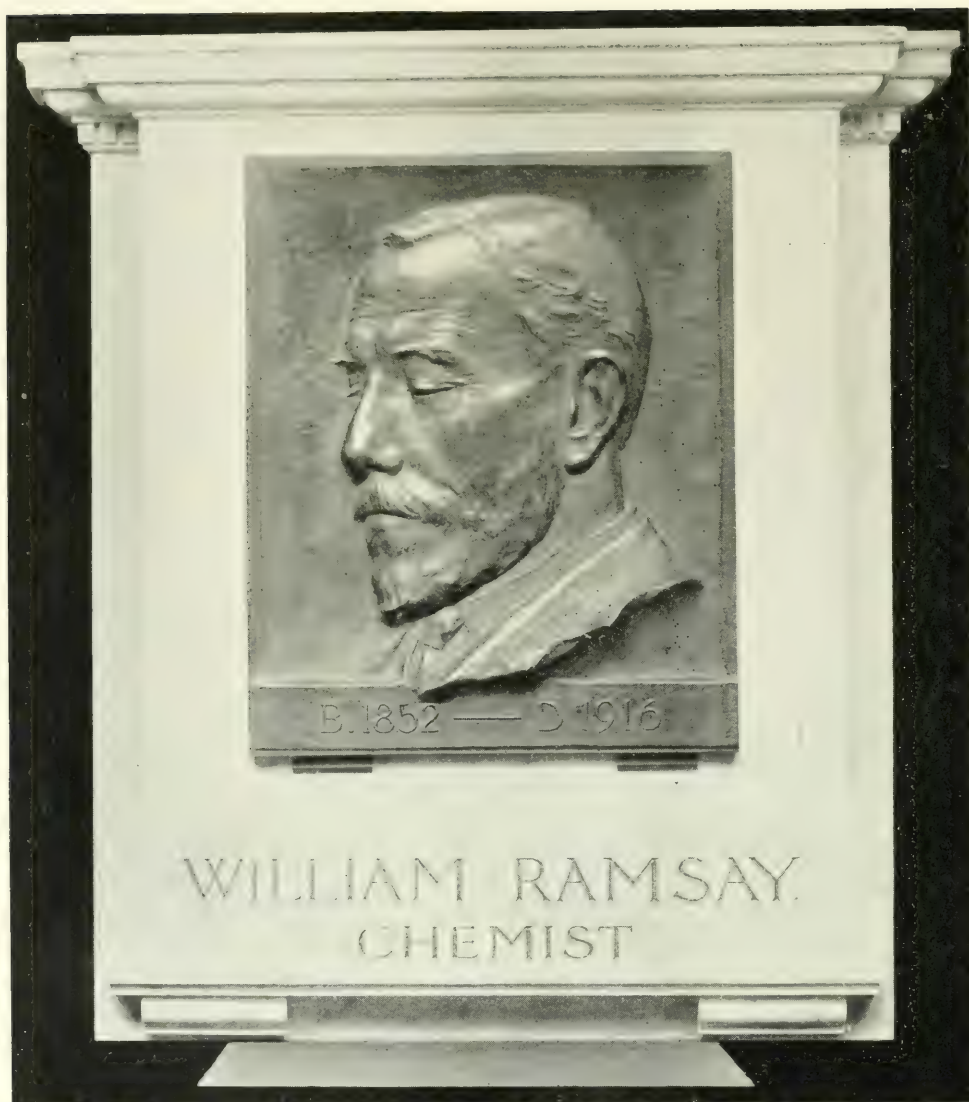
- 160777—Acree, S. F.—Methods of converting wood into mucic acid and other products.
- 186144—White, A. E.—Manufacture of white lead.
- 186107—Imray, O. Y.—Manufacture of resins.
- 186118—Thompson, W. P.—Lead alloys.

Abstract Published this Week.

Oxalic Acid.—Patent No. 184627.—An improvement in the process of producing Oxalic Acid has been Patented in this country by Messrs. Badische Anilin & Soda-Fabrik, Ludwigshafen-on-Rhine, Germany.

Wood or other material containing cellulose is treated with nitric acid, or with oxides of nitrogen and water, in the presence of a catalyst which may consist of a compound of iron, of rare earths or their compounds, or of magnesium compounds. In examples, nitric acid solutions of iron nitrate or of didymium nitrate are used at temperatures of about 60° C. With magnesium compounds higher temperatures are used, so that the salt is melted in the presence of water. The nitric acid may be supplied from magnesium nitrate when employed as catalyst, by heating it to about 160-170° C. and gradually adding the wood to the fused salt. When magnesium chloride is used nitric acid is added and the temperature raised to about 170-190° C.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.



The Ramsey Memorial Tablet

UNVEILED IN WESTMINSTER ABBEY ON FRIDAY, THE 3rd NOVEMBER, BY HIS ROYAL HIGHNESS, THE DUKE OF YORK.

We are pleased to record that the name of Sir William Ramsay has been fittingly honoured by the erection of a tablet in Westminster Abbey.

Those of us who knew him feel that the honour is well deserved; he was a brilliant investigator, an indefatigable worker, a kindly teacher, and a warm-hearted gentleman.

The unveiling service was attended by a large number of his friends, and after the ceremony His Royal Highness was presented with the Ramsay Memorial Gold Medal by His Excellency the French Ambassador.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3265

FEDERATION OF BRITISH INDUSTRIES.

SPEECH BY COLONEL O. C. ARMSTRONG
(PRESIDENT), AT THE CALEDONIAN HOTEL,
EDINBURGH, OCTOBER 31ST, 1922.

When you kindly invited me to visit you we none of us anticipated that the date you had chosen would so closely coincide with that of a General Election.

NECESSITY FOR RIGID ECONOMY AND REDUCTION OF TAXATION.

As you are well aware, the Federation takes no part or hand in politics. There is, however, one question which affects the whole of the community, and this prospective members of all parties should be called upon to answer before they receive support at the polls, namely, whether they will use their utmost strength to support a policy which will enforce on the Government rigid economy, and demand that such economies be in greater part applied to the reduction of the intolerable burden of taxation under which we are now suffering. I would ask all members of the Federation who are present here to-day, whatever their political creed may be, to insist that the candidate to whom they intend to give their vote should give frank, clear and definite pledges that he will further such policy if he be elected.

It is impossible for industry to improve its position so long as it is overweighted with taxation, both national and local. If this burden is to be lightened it will be in-

cumbent on the new Government to make far more serious effort than their predecessors have done to reduce expenditure. It is a difficult and unpleasant mandate to carry out. Economy is popular in principle, but it is desperately unpoular in its application especially among those who are called upon to make sacrifice either in person, or in the deferment of some of their cherished ideal schemes of betterment. Unfortunately at present the welfare of the entire community is dependent on the acceptance of such sacrifice. The new Government will not only need great courage but must also be prepared to be at least for some time one of the most unpopular administrations which this country has ever possessed.

PROSPECTS OF TRADE REVIVAL.

The Government may possibly find compensation and encouragement in its acceptance of this unpleasant role in the fact that the industrial outlook is not quite so gloomy as it has been for the last eighteen months. At the moment there are slight indications that the clouds are breaking though they are not lifting. There are slight signs of a revival in a certain number of industries. One can only express the most sincere hope that these faint signs may multiply, become more definite and of wider extent to such degree that one may find sufficient justification to forecast that a steady and general upward trend is in progress. Only when such movement is steady and simultaneous will it be possible to maintain that we are nearing the end of the slump and approaching the commencement of better times.

Should these portents materialise, it will be up to us individually and collectively to concentrate all our energies towards in-

creasing the momentum of the movement. We shall perhaps be in a better position to exert such energy in that the evil days we have passed through have taught us salutary lessons, among others the stern need for the lowering of the cost of production if we are to regain our place in the world's trade. Much has already been done in this direction, and I think and sincerely hope I am justified in saying that with a possible revival of trade in sight we shall be able to rely on even greater co-operation on the part of labour than we are at present counting upon.

RAILWAY RATES, DOCK CHARGES AND FREIGHTS.

Besides the factors I have already referred to, there are other direct causes which seriously penalise our trade. Among the more important of these, I would cite railway rates, dock charges and freights. With improved trade, more economic administration and lower working costs, there is no doubt that all these charges can be very materially reduced. The present scales constitute an intolerable handicap, and it is incumbent on us to continue to press for further serious reductions also for a removal of the many existing anomalies in reights, which in certain cases result in preferential rates being given to goods shipped from Continental ports.

It is within your knowledge that the Federation recently took the decisive lead in inducing the Railway Companies, both English and Scottish, to reduce their rates. Similarly pressure is being brought to bear by the Federation to effect a reduction in dock charges. I can assure you that with your assistance and support the Federation will continue its efforts to bring about such readjustments in transit charges as will prove beneficial to the interests of our trade.

DIFFICULTIES IN EUROPEAN MARKETS AND EFFECT OF EXCHANGES.

The chief difficulty which lies in our way is the condition of the majority of our European markets. Most are suffering from exchanges so depreciated that buying from Great Britain becomes almost an impossibility. Some of them, such as Russia, are virtually shut off from us. It is interesting to recollect that in 1913 Russia, Austria and Germany purchased from this country £63,000,000, or 12 per cent. of our total exports.

ADJUSTMENT OF REPARATIONS AN ESSENTIAL ANTECEDENT TO RECOVERY OF EXCHANGES.

The more one considers this question, the more one is forced to the conclusion that an essential antecedent to the stabilisation of the exchanges is a reconsideration and a readjustment of the reparation claims. However much the Germans may have been to blame in the earlier days for the depreciation of the mark, there can be little doubt now that inflation has run away with them until at the present moment they are on the verge of a complete financial collapse, owing to the fact that the mark, at 20,000 to the £, is beginning to go out of effective circulation.

A bankrupt Germany so far from assisting towards any possible solution will only complicate it and render our position in this country worse than it is at present, since in its train it will inevitably drag the financial position of France, Belgium, and other countries to a lower level than that at which they now stand.

While holding that Germany should be made to pay every penny that she can possibly afford, we have to-day to face the question more from a practical than a moral point of view. We are now being forced to realise that the stabilisation of European exchanges depends upon Germany's position and that we must consequently revise the reparation claims, definitely decide how much she may be able to pay within a certain date, to concede to her a moratorium for the necessary period of time, Germany, on the other hand, giving satisfactory assurances that she will balance her budget, close her printing press, and set her house in order. I believe that the feeling of alarm at the sudden collapse of her currency values is of sufficient extent to ensure her in her own interests taking steps in this direction if only the question of reparations can be adjusted on a practical basis.

PLAIN SPEAKING AND ACCEPTANCE OF REALITIES.

To my mind the one way in which this can be done is at a round table conference, where plain speaking is allowed to prevail and the acceptance of unpleasant realities admitted. There are obviously very great difficulties in bringing such a conference to a successful conclusion, but our friends the French must realise that the point has been reached at which, if they maintain

their impossibly intransigent attitude, their interests in reparation payments will disappear, and they will not obtain from Germany even the lesser amount which might now accrue to them by the acceptance of a prompt and reasonable compromise.

The situation has now become so serious, the contingent effects so widespread, that immediate and drastic action is necessary. Every effort should be made to induce the new Government to deal with this question forcibly and at the earliest possible opportunity. It is inevitable that any understanding which may be come to will imply a prolonged moratorium in regard to the debts due to us by our Allies. Though we are in no way prepared to cancel these obligations, nevertheless we should readily agree to any deferment that may be necessary, if by so doing we can secure co-operation in the first step towards stabilising exchanges.

HOSTILE TARIFF BARRIERS.

A further retarding influence on our recovering certain markets lies in the hostile tariff barriers which are being put up by many of our former friends. Apart from the question of the American Tariff, which raises its own particular difficulties, there has been a general tendency throughout the world since the close of the war to raise higher and higher tariff walls, and even in those countries to which exchange and other conditions render it possible to export, these tariffs have become a serious detriment to British trade.

For some time the Federation has been keeping his aspect in regard to particular countries and particular tariffs before the attention of H.M.G. They have supplied the Departments concerned with these matters with fuller information than they have ever received before as to the effects of these tariffs upon industry. I am glad to think that in such matters as the recent Treaty negotiations with Spain, the assistance this Federation was able to render, both in preparing the way by a special unofficial mission for the more formal official negotiations, and by supplying advice and information during the negotiations, has been one of the principal factors in securing a comparatively satisfactory result, and that the spade work which has been done in regard to other countries and their tariffs may well bear fruit during the coming year.

Nevertheless, I consider that it will be one of the more important tasks of the Federation during the forthcoming year to urge upon our Government that they should apply both more serious attention and more vigorous action to breaking down these barriers which are impeding the recovery of our trade.

BETTER PROSPECTS IN MARKETS OUTSIDE EUROPE.

As regards foreign markets in general, it appears to me that we should in the immediate future look outside Europe, for instance to S. America and the Far East, for any substantial increase in our export trade. There are certain factors in existence which may be of considerable assistance to us.

The force of German competition is weakening as her financial position becomes worse: while the present U.S. policy in regard to both tariffs and the inter-allied debts will have a considerable reaction upon their power to compete in external markets.

There remains one market, the possibilities of which are being widely canvassed at the present moment. I refer to the British Empire.

THE EMPIRE: LIMITING FACTORS TO AN IMMEDIATE EXTENSION OF TRADE.

In the Empire, we have great natural advantages in similarity of ideas, identity of language, and relatively favourable tariff and exchange conditions, and from the broad Imperial point of view there can be no possible doubt that every step we take for the furtherance of inter-Imperial trade will in the long run redound to the benefit of the Empire as a whole and of each constituent part. But we must remember that there are many limiting factors to any immediate increase of that trade, and that we must not pitch our hopes too high.

Recent discussions have referred more particularly to our Overseas Dominions, namely, Australia, New Zealand, Canada, and the Union of S. Africa. Now the population of these four Dominions only amounts to 22,000,000.

Although we know that the purchasing power per head in most of the Dominions is high (in 1921 they took 15½ per cent. of our exports), there is an obvious limit to the absorbing capacity of markets with a relatively small population. Again, there

must be limits to the productive power of areas, however vast their potential resources, unless those resources can be developed by an adequate population.

It would be unreasonable to expect that we could make a very substantial increase in our trade with these Dominions until sufficient time has elapsed for them to increase their populations.

LOCAL INDUSTRIES IN DOMINIONS SHOULD BE ASSISTED.

That such increases will serve to add strength to the present movements towards fostering local industries is inevitable. We must regard this movement from the broadest point of view, we must welcome it and assist it actively by ensuring that such developments are effected by the support of British capital, lest we find that, as is already the case to consider the extent in Canada, that capital has been supplied by competing countries. If a sane and healthy development of local industries takes place with the assistance of British capital and with due regard to the real industrial potentialities of the Dominions concerned, such a development can only tend to increase the general level of prosperity and consequently the growth of our trade with such Dominions.

NECESSITY FOR INCREASE OF POPULATION.

These conditions are all dependent upon an increase of population, and it is of the greatest importance that the Government should, in co-operation with the Dominion Governments, expand and perfect schemes of emigration to those parts of the Empire which are in need of additional population. For these reasons we cannot look to those Dominions for any immediate assistance in facing the problem of our foreign markets. We cannot, therefore, afford meanwhile to relax our endeavours in other parts of the world.

In India, we are faced with the difficulties of the political situation and possibly of a fiscal policy which may hamper any extension of British trade. In regard to India I am afraid we can only say that the prospects of an immediate increase of our trade must be slight, and that we may even find difficulty in maintaining it at its present level.

I am a firm advocate of doing everything which is possible to stimulate and develop our trade within the Empire. I look to this trade to be eventually the solution of many of our present problems, both econo-

mic and political. I believe that every effort should be made to stimulate such trade, and to lay the foundations for its increases, but we must realise that such an increase can only be gradual, that thought and labour must be given to the solution of the problems involved, and that we shall have need of much patience before we see the fruits of our efforts. We must remember that the development of the consumption power of any market is necessarily slow and dependent upon the power of that market to develop its own production so that the consumption can be paid for.

Whether this development will proceed smoothly, and upon sound and healthy lines, will depend very largely upon the wisdom and foresight of all concerned, and particularly, perhaps, on those responsible for the financial and general policy of the Dominions themselves. Development will not be assisted if we in this country rush into ill-considered schemes, or if through a lack of appreciation of the legitimate needs and ambitions of the Dominions themselves, we attempt to force upon them schemes based too much upon our own present necessities.

A SIMPLE MATHEMATICAL CONCEPTION OF THE DENSITY OF THE ELEMENTS.

BY LEON A. CONGDON

(*Chemistry Department, Syracuse University, Syracuse, New York*).

INTRODUCTION.

Perhaps no other physical property of the elements has puzzled the chemist and physicist more than density, or as it is more commonly called, specific gravity.

It has been recognised nevertheless that, considered as a series, the most remarkable correlative attribute of the elements is their specific gravity. The atomic volume—atomic weight curve of Lothar Meyer (1) shows us that the atomic volume of the element is a periodic function of the atomic weight, but shows us very little relative to quantitative considerations of the density of the elements. In fact, if we try to find any exact mathematical relation of the density of the ele-

(1) "Outlines of Theoretical Chemistry," 1899.

ments from the periodic table of Mendelëeff, we will find it impossible to draw any such conclusion. The periodic table, being merely qualitative in character, and based upon the maximum valency being eight, does not give us exact conclusions, for elements show different valencies according to the conditions and the elements with which they combine—especially with oxygen. In other words, valency is a variable quantity.

E. Bradbury (2) attempted to group the elements according to their specific gravity in only a rough way, but he made no quantitative classification—merely showing a few relationships in atomic weights which exist between analogous elements classed according to specific gravity.

G. Woodiwiss (3) tried to show some relation between atomic weight, valency and specific gravity. He states that the specific gravity of non-metallic elements possessing the same valency are proportional to their atomic weights, but groups with different valencies are connected by this relation:—Specific gravity divided by square root of valency is proportional to atomic weight. Further that inert elements of the argon group come under this so-called law by assigning to them the valency 0.5. The valencies given are different than those which have been found by experiment, thus Cu and Ag are given as seven, Zn is six Co is eight, etc. Thus his relationship is not based on experimental facts in the case, and devises nothing new than was practically brought forth by Borchers (4), who finds that if the equivalent volumes (atomic volume divided by maximum valency) are employed instead of the atomic volumes, the atomic volume—atomic weight curve of Lothar Meyer—is more regular and the relations stand out more clearly. Borchers tries to fill in the gaps of the curve, and ventures to predict the atomic weights and densities of unknown elements.

Samuel Smiles (5), in his discussion of volume relations, says that Schroder's (6) work on atomic volume seems to be of fundamental character, and although it was impossible to find any definite physical interpretations for it, it seems to contain the germs of comprehensive law governing volume and chemical composition, and that we have some indication of an intimate connection between volume and valency. Schroder's work shows that the atomic volume, although variable, is always a simple multiple of a certain volume unit called the "stere." The so-called "stere" is not the same for all elements, but it varies within quite narrow limits. Further, when two elements are combined, one of them assumes the volume unit of the other; the stere of one of the elements seems to dominate the volume of the compound.

It will thus be seen from the above summary of the most important and fundamental work on density, that we do not at present have any clear quantitative connection with atomic weight and valency other than that of a general idea that in compounds the volumes of equivalents of different elements are approximately equal, or stand in some simple ratio to one another, with perhaps some indication of an intimate connection between volume and valency.

The purpose of this study of the density of the elements was first to correlate in a quantitative way the density of the elements themselves. The next step was the relation with specific heat, since it was noted that, in general, as the density of the elements was increased the specific heat was decreased. The correlation of specific heat, density, and valency was attempted, likewise these relations with atomic number of the elements. The results obtained in these classifications, where maximum valency toward oxygen was used, are given under the experimental part of this paper. The known maximum valency toward oxygen of some of the elements cannot be used to obtain con-

(2) *Chemical News*, 1906, XCIV., 157-8, 245.

(3) *Chemical News*, 1908, XCVII., 122-4, 265 (1908).

(4) *Die Beziehungen zwischen äquivalent Volumen und Atomgewicht*. Halle, 1904.

(5) "The Relations between Chemical Constitution and Some Physical Properties," *Ramsay Series of Physical Chemistry*.

(6) *Pogg Ann.*, 1840, LXI., 553; *Wied. Ann.*, 1898, IV., 135; 1889, XI., 997; 1881, XIV., 656; *Ber.*, 1877, X., 848, 1871.

stant results, and the theory is advanced that we have not as yet found by experiment this maximum valency toward oxygen for a few of the elements. From the scheme proposed, this maximum valency toward oxygen can be ascertained.

EXPERIMENTAL STUDY.

If the density of the elements are ar-

ranged in their natural order and are grouped in fives, we find the following mathematical relationship among the elements in their solid state. The gases are calculated to the average density as they would be found in a solid chemical compound, if such compound were made. The average temperature at which the densities were taken was about 25° C.

TABLE I.

Density of the Elements.

0.1	0.6	1.1	1.6	2.1	2.6	3.1	4.1	5.1	6.1	6.6	7.1	8.1	9.1
—	I ₂ .	Dy.	Ca. S(Nat)	B.	Br.		Zr.	—	Nb.	Ce.	Zn.	Rd.	Mo.
	0.59	1.1	1.57	2.07	2.68	3.14	4.15		6.1	6.63	7.1		9.0
0.2	0.7	1.2	1.7	2.2	2.7	3.3	4.3	5.3	6.2	6.7	7.3	8.3	9.3
H.	Kr.	Cl.	Mg.P (Red)	Al.	Ho.		Se.	Ge.	La.	Sb.	In.	Co.	Tm I
0.21	0.73	1.2	1.74	2.2	2.7		4.28	5.46	6.2	6.71	7.28	8.5	
0.3	0.8	1.3	1.8	2.3	2.8	3.5	4.5	5.5	6.3	6.8	7.5	8.5	9.5
He	K.	Gd.	O.	Si.	N.	C.	Ti.	V.	Te.	Cr.	Mn.	Cd.	Tm II
0.31	0.86	1.31	1.79	2.3	2.8	3.51	4.5	5.5	6.25	6.8	7.37	8.64	
0.4	0.9	1.4	1.9	2.4	2.9	3.7	4.7	5.7	6.4	6.9	7.7	8.7	9.7
Ne.	Xe.	F.	Cs.	Eu.	Tb.	Ba.	Er.	As.	Pr.	Nd.	Sm.	Ni.	Yb.
0.42	0.90	1.4	1.88			3.75	4.77	5.72	6.47	6.96	7.7	8.7	
0.5	1.0	1.5	2.0	2.5	3.0	3.9	4.9	5.9	6.5	7.0	7.9	8.9	9.9
A.	Na.	Rb.	Be.	Sr.	Sc.	Y.	L.	Ga.	Sn.	(R'm'e)	Fe.	Cu.	Bi.
0.55	0.97	1.52	1.93	2.5	3.0	3.8	4.94	5.92	6.55	Lu.	7.86	8.93	9.8
Diff. 0.1							0.2	0.1	0.2	0.2			
10.1	11.1	12.1	13.1	19.1									
E. N ₂	Th.	Rh.	Act.	W.									
	11.0	12.1		19.1									
10.3	11.3	12.3	13.3	19.3									
E. I.	Pb.	Ru.	—	Au.									
	11.34	12.26		19.3									
10.5	11.5	12.5	13.5	21.5									
Ag.	Pd.	E. Cs.	Hg.	Pt.									
10.5	11.5		13.55	21.4									
10.7	11.7	12.7	16.7	22.7									
E.Mn.	Ux.	Po.	Ta.	Ir.									
	I.		16.6	22.4									
10.9	11.9	12.9	18.9	22.9									
E.Mn.	Tl.	Nt.	U.	Os.									
	11.85		18.7	22.48									
0.2													

From the above mathematical conception of the density of the elements, it is quite possible that the first thirty elements, arranged according to their increasing density, differ by a gradual increase of one-tenth; the next fifteen by a gradual increase of two-tenths; the next ten elements by one-tenth; the next thirty by two-tenths; and the last ten elements seem to have the following relation: the first three increasing in density by two-tenths, the fourth element increasing from the third of this group by three and two-tenths, the fifth element from the fourth by two and two-tenths, the sixth element from the fifth by two and two-tenths, the seventh from the sixth by two-tenths, the eighth from the seventh by two and two-tenths, the ninth from the eighth by one and two-tenths, and the tenth from the ninth by an increase of two-tenths.

Having classified the density of the elements themselves, the next step is to find in an indirect way the relation of density to the chemical characteristics of the elements, if such exists. After considerable experimentation with the known chemical and physical constants of the elements, it was decided to use constants which could be determined for practically all known elements. These constants are the Atomic Numbers of Moseley and the Specific Heats at 100° C. of the elements. The particular significance of Moseley's Atomic Numbers is that the Atomic Numbers represent the number of unit positive charges of electricity in the nucleus of the atom of each element. Again the Atomic Numbers place the elements in their correct chemical order, leaving a place for the rare earths which have no satisfactory place in the Periodic System of classification. The significance of the Specific Heats of the elements is Dulong and Petit's well-known law, connecting specific heat and atomic weight, this law becoming quite constant when the specific heat is taken at 100° C. of the element, the constant being approximately 9.5 for the rare gases.

Now if the elements are arranged according to their maximum valence toward oxygen, we find the elements classed into groups, each group having characteristics similar in their chemical properties. The relation of these chemical properties is mathematically expressed by the following formula, which connects density, specific heat at 100° C. of the element, atomic number, and valency:—(Density x Specific Heat at 100° C. of the Element x Atomic Number), divided by the Maximum Valency toward Oxygen. The elements group themselves into fives as in the classification of density, but different groupings are observed as regards the elements themselves. The following table gives the following concept as regards such relation:—

TABLE II.

Relation of Density, Specific Heat at 100° C. of the Element, Atomic Number, Maximum Valency toward Oxygen, and Average Chemical Characteristics.

Group No. of Figures in these columns represent the following form—
(Maximum Valency toward Oxygen) :—(Density x Specific Heat x Atomic Number) divided by the Group No. of the Element.

0.	He.	Ne.	A.	Kr.	X.
	1.5	2.0	2.5	3.0	3.5
1.	He.	O.	F.	Cl.	Br.
	1.5	2.0	2.5	3.0	3.5
1.	Li.	K.	Na.	Rb.	Cs.
	1.5	2.0	2.5	3.0	3.5
2.	Ca.	Mg.	Bc.	Sr.	Ba.
	1.5	2.0	2.5	3.0	3.5
3.	Gd.	B.	Al.	Sc.	Y.
	1.5	2.0	2.5	3.0	3.5
3.	Er.	La.	Ga.	Ir.	Nd.
	4.0	4.5	5.0	5.5	6.0
3.	In.	Sm.	Co.	Fe.	Ni.
	6.5	7.0	7.5	8.0	8.5
4.	C.	Si.	Ti.	Zr.	Ge.
	1.5	2.0	2.5	3.0	3.5
4.	Ce.	Zn.	Rd.	Cd.	Cu.
	4.0	4.5	5.0	5.5	6.0
4.	Th.	Pb.	Pd.	Rh.	Hg.
	6.5	7.0	7.5	8.0	8.5
5.	N.	P.	V.	As.	Sb.
	1.5	2.0	2.5	3.0	3.5
5.	Sn.	Nb.	Bi.	Ag.	Tl.
	4.0	4.5	5.0	5.5	6.0
5.	Yb.	Lu.	—	Ho.	Tb.
	6.5	7.0	7.5	8.0	8.5
6.	S.	Se.	Te.	Cr.	—
	1.5	2.0	2.5	3.0	3.5
6.	Eu.	Dy.	Po.	Nt.	Act.
	4.0	4.5	5.0	5.5	6.0
6.	Ux.	E.Cs.	Ta.	W.	U.
	6.5	7.0	7.5	8.0	8.5
7.	Tm.I.	Tm.II.	I.	Mn.	Mo.
	1.5	2.0	2.5	3.0	3.5
8.	Ru.	E.Nd.	E.I.	E.Mn.I.	E.Mn.
	4.0	4.5	5.0	5.5	6.0
8.	Pt.	Ir.	Os.	Au.	—
	6.5	7.0	7.5	8.0	8.5

The mathematical conception given in Table II. was derived from averages, for it was found that we have a mathematical periodic relation. The first twenty elements containing the group numbers of 0, 1, and 2, and the first five members of groups 3, 4, 5, 6, and 7 in rotation gave the following formula numbers: 1.3, 1.8, 2.5, 3.1, and 3.7. The second five members of group numbers 3, 4, 5, 6, and the first five members of group 8 gave the following formula numbers: 4.1, 4.9, 5.3, 5.7 and 6.0 as the averages. The third five members of group numbers 3, 4, 5, 6, and

the second five members of group 8 gave the following formula numbers: 6.6, 7.0, 7.5, 7.9, and 8.6. From these formula numbers, it was therefore easy to construct a ratio of formula numbers that would be reasonable to expect working from the last members of the higher groups backwards, since it is easier to obtain the specific gravity and especially the specific heat of the heavier metals more exact. The mathematical conception, therefore, was as given in Table II., namely: 1.5, 2.0, 2.5, 3.0, and 3.5 for the first series; the second series being 4.0, 4.5, 5.0, 5.5, and 6.0; and the third series being 6.5, 7.0, 7.5, 8.0, and 8.5. It is seen that the members of each group number differ by exactly five-tenths. The differences of the average group formula numbers and the exact concept as given in Table II. must be attributed to the temperature at which the specific heat was taken; it was therefore thought best to construct a table of specific heats from the exact relations found out by the indirect method of averages from the formula giving the relation between the density, specific heat, atomic number and group number of the elements.

(To be continued.)

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION I.—PHYSIOLOGY.

THE EFFICIENCY OF MAN AND THE FACTORS WHICH INFLUENCE IT.

ADDRESS BY PROFESSOR E. P. CATHCART,
M.D., D.Sc., F.R.S., PRESIDENT OF THE
SECTION.

The subject of my address—the efficiency of the human organism and the factors which influence this efficiency—is, in my opinion, one of the most important problems of the present day. It is a problem which cannot, however, be considered only from its physiological aspect if it is to receive adequate consideration; its implications are much wider, reaching right down to the very basis of our daily lives. As I am no expert in industry or economics, I shall confine my attention as far as possible to the problem from the physiological side, and leave to others the sociological application.

The term "efficiency" has become a mere catchword, bandied about by people

who have not the faintest idea of what the word connotes. Practically it has come to mean, to the average man in the street, the mythical improvement which is to be anticipated from some change in workshop or office organisation—a bigger and better result at a smaller cost. The word has a very definite meaning in engineering science, and this meaning has been transferred from the inanimate machine to the living organism. In the case of the engine the problem is relatively simple, as the number of interfering factors is not great, but the solution of the problem in the case of the organism is beset with many difficulties, as the interfering factors are numerous and varied. Two types of efficiency are spoken of in connection with the animal body. One type is the mechanical efficiency in the engineering sense, *i.e.*, the ratio which exists between the heat equivalent of the external muscle work done and the energy output of the subject during the performance of the work in question. This is a problem which has attracted many workers, and there seems to be a general consensus of opinion that the efficiency of man in the performance of external work is about 20 per cent. gross and 25 per cent. net. (Gross efficiency is obtained by dividing the actual heat equivalent of the external work done by the total output of energy of the man during the time occupied in the performance of the external work, and *net* efficiency is obtained by dividing the heat equivalent of the external muscle work done by the actual increase in the energy output of the subject over the basal energy output during the performance of the work in question.) As A. V. Hill has pointed out, this striking unanimity is in all probability due to the fact that the maximum value of efficiency remains more or less constant over a fairly wide variation in the mode of the performance of the work. The work referred to here is wholly concerned with muscle activity. The other type of efficiency is that which is called industrial or productive efficiency, where the capacity of the individual to perform effective work is dealt with, judging the capacity of the individual by, for example, his output in unit time. So far as the worker himself is concerned, the whole object in industrial efficiency is undoubtedly to get the greatest output with the minimum of effort. The determination of the mechanical efficiency is fairly readily carried out, but it is very difficult to get an

accurate gauge of the industrial efficiency. At bottom they are closely related, and both are physiological problems.

The leaders of industry have not been slow to accept and utilise the gains of science in the realm of inanimate things, but they have been slow to recognise the fact that there is a science of physiology which deals with the man who controls the productive machinery. New inventions may completely revolutionise shop equipment, good machines may be replaced by better, and better by still better, but man remains almost as immutable as the ages. Physiological evolution is infinitely slow. As Lee puts it, "Try as we will, we cannot get away from the fact that so long as machines need men, physiological laws must be reckoned with as a factor in industrialism." Butler, in "Erewhon," satirised in his inimitable way this very problem of the industrial world as follows: "So that even now the machines will only serve on condition of being served, and that upon their own terms; the moment their terms are not complied with they jib, and either smash both themselves and all whom they can reach, or turn churlish and refuse to work at all. How many men at this hour are living in a state of bondage to the machines? How many spend their whole lives, from the cradle to the grave, in tending them night and day? Is it not plain that the machines are gaining ground upon us, when we reflect on the increasing number of those who are bound down to them as slaves and of those who devote their whole souls to the advancement of the mechanical kingdom? . . . May not man himself become a sort of parasite upon the machines? An affectionate machine-tickling aphid?"

It is a clever picture, and if one looks back on the rise of industrialism it is not so very far-fetched. It is but a little more than a hundred years since this country was industrialised, and we are still reaping the aftermath of the terrible conditions which then reigned, when the great centres of industry were swamped with country dwellers who poured into the towns in the race for wealth. Few realise the hopelessly unphysiological conditions which developed in the methods of work, the hours and conditions of work, the housing. Many talk now of the hardship of the eight hours' day under conditions which are relatively civilised, where the place of labour and the methods and machinery used are super-

vised by skilled and honest Home Office inspectors, where child labour is firmly controlled, and where practically all abuses are checked. The following citation from Robert Owen, that "shrewd, gullible, high-minded, wrong-headed, illustrious and preposterous father of Socialism and Co-operation," as Lytton Strachey calls him, gives a good idea of the conditions ruling in the early years of last century in one of our staple industries. "In the manufacturing districts it is common for parents to send their children of both sexes at seven or eight years of age, in winter as well as summer, at six o'clock in the morning sometimes, of course, in the dark, and occasionally amidst frost and snow, to enter the manufactories which are often heated to a high temperature, and contain an atmosphere far from being the most favourable to human life, and in which all those employed in them very frequently continue until twelve o'clock at noon, when an hour is allowed for dinner, after which they return to remain, in a majority of cases, till eight o'clock at night." Six till eight, with a break of one hour: a fourteen hours' day, and fifteen was not unknown. Owen, in the article from which I have quoted, was petitioning Parliament, asking what? That a twelve hours' day be instituted, to include one and a-half hours for meals, and that no child should be employed until the age of ten was reached. He pointed out in the course of the article that the results from the manufacturers' point of view would be better with a twelve hours' day (*i.e.*, that the industrial efficiency, in modern words, would be improved).

Yet we wonder that the offspring of stock descended from workers under these conditions, which certainly improved as the century advanced but were far from ideal, gave the high yield of C3 lads recorded in the National Service Report. We might have been prepared for the disclosure, as the pre-war records of countries with conscription showed that the number of rejections for the Army of town and factory workers was far in excess of those for men drawn from country districts. But evidence of the state of the national physique is not confined to these war figures. Sir George Newman, in his valuable and interesting Report on Preventive Medicine, has drawn attention to the enormous amount of time which is annually lost through sickness. The minimum average

amounted to 14,295,724 weeks (or a period of upwards of 270,000 years) of sickness per annum, and this figure did not include absence from work due to maternity benefit, sanatorium treatment, or absence for less than four days per patient. This is the evidence of the National Health Insurance.

The design of the organism which has to stand the strain is not at fault. It is an organism which, in the language of the engineer, is abundantly supplied with factors of safety, and has an over-all high factor of safety. The body is not designed merely to perform the minimum amount of work or to stand the minimum strain; there is always a reserve. We have a circulatory system which is beautifully balanced to meet a strain, a system of vessels whose calibre can be increased or diminished so that the blood may be mobilised at the tissues or organs which require it, and a heart which has the capacity, provided it is normal and healthy, of responding to work, whose rate may be trebled in a few seconds when oxygen must be obtained and carbon dioxide got rid of. Not only can the amount of blood which is passed through the lungs during hard work be increased some five times, but the amount of oxygen taken in may rise ten times. Thus the subject studied by Benedict and myself had a normal consumption of about 200 cc. oxygen per minute, and in one experiment he kept up an intake of nearly 2,000 cc. per minute for four hours and twenty-two minutes on end. Quite often the same subject used 2,700 cc. to 3,000 cc. for ten minutes at a time.

Again, at rest less than a third of the oxygen present in the blood is required, and even in the very hardest work the arterial blood is not depleted of its oxygen; it probably still contains more than a fourth. Curiously enough, the actual effectors, the muscles, do not of themselves seem to have a very high factor of safety. The structures, bones, and cartilage, to which they are attached, and which limit their action, and the amount of strain to which they can be exposed or subjected, have a very high factor of safety. A further protective mechanism for muscle is the perfect co-ordination between the groups of muscles, the elucidation of which problem we owe largely to our President, Sir Charles S. Sherrington. We have another reserve of first-class importance—viz., that when the strain on one group of muscles is becoming too severe, more and more groups of muscles are brought into action to help in meeting the strain, until in the end, if need be, practically the total musculature of the body is involved. And behind all this there are final factors of safety such as fatigue, which is a protective warning; and finally, if the latter be not heeded, collapse.

This perfect co-ordination of the different parts of the organism is required, because the human being is capable of intense muscular exertion for short periods. The intensity of the work is as a general rule inversely proportional to the length of time during which it must be carried out. The following table (Table I.) gives some idea of what is probably about the maximum effective muscular work per minute (modified from Blix):—

TABLE I.

Nature of Work.	Duration of Work.	Effective Muscular Work per min.	
		Kilogrammètres	Calories.
Mountain climbing, moderate	Many hours	500	1.16
Mountain climbing, severe	1 to 2 hours	750–1,000	1.74–2.33
Mountain climbing, very severe	3.75 minutes	2,000	4.65
Treadmill	30 seconds	2,400–3,600	5.58–8.37
Running upstairs, 10 Kg. load	15 seconds	3,700	8.61
Running upstairs, no load	30 seconds	4,300	10.00
Running upstairs, no load	4 seconds	5,700–6,000	13.26–13.95

If, in the human organism, we were merely concerned with the co-ordinated action of a series of effectors, with the capacity of a certain group of muscles to perform a given amount of work, the solution of the problem would be relatively simple. But we are dealing with a living organism capable not only of doing work but of repairing the worn-out parts, as and when required. Further, we are dealing with an organism which varies not only in its capacity to perform work, but in its "will to work." We are dealing with a subtle organism which has a whole series of protective mechanisms at its command, an organism which can be fatigued and rendered useless, as a working unit, by an amount of work on a particular day which on another day it can perform with the utmost ease and without apparent fatigue. We are dealing with an organism which can and does perform real hard muscular work with vigour and joy, and yet, if the nature of the employment or the environment be distasteful, can be reduced to impotence by work capable of being done by a child.

Again, the efficiency of a man is not merely dependent on the amount of work which can be performed by his muscles; the circulatory, respiratory, and nervous systems are of equal importance, and all are intimately related. The muscles must receive an abundant supply of blood, not merely to bring nutriment but to remove waste; there must be an efficient exchange of gases in the lungs, the rate of the respiratory and cardiac movements must be adapted to the work in hand through the co-ordinating agency of the central nervous system. Not only so, but, if the man is to work with the minimum of waste energy, there must be proper co-ordination between the various groups of muscles. A man does not walk, for instance, by the aid of his leg muscles alone, his lumbar muscles are equally important. Further, it is not a mere question of autonomic reflex adjustment, important though this may be, for much of the work done the attention must also be invoked. Yet, in spite of the many and varied stresses and strains to which the organism is subjected in the course of life, as the result of the many factors of safety, unless the overloading is excessive, too frequent or too long continued, the organism, so long as it remains physiological, is practically unaffected by ordinary hard work.

If we turn now to the consideration of

the factors which influence the efficiency, both in the mechanical and the industrial sense, we find that the main controlling factor is undoubtedly the condition known as fatigue. Fatigue is a word just as frequently used as efficiency, and yet it is almost impossible to give an accurate definition of the term. Generally speaking, it is to be regarded as the antithesis of efficiency. As Vernon put it, "By so much as fatigue is avoided or eliminated in industrial operations the efficiency of the worker is increased." Fatigue may be summarised as a diminished capacity for doing work. The question of the site at which fatigue is first manifested, whether it is a central or a peripheral phenomenon, whether it is a specific condition, or whether, as Crile maintains, there is no ultimate difference between the bloodless intangible causes of fatigue and exhaustion and the bloody tangible causes of "shock," lies without the scope of this address. One of the great difficulties in the solution of the question is that no one has as yet devised a method which permits of a quantitative determination of the degree of fatigue. Indeed, some workers, Muscio for example, have definitely stated that such a test is an impossibility.

(To be continued.)

MEETINGS OF SOCIETIES.

THE ROYAL SOCIETY.

THURSDAY, NOVEMBER 2, 1922.

Papers read:—

LORD RAYLEIGH, F.R.S.: *Polarization of the Light Scattered by Mercury Vapour near the Resonance Periodicity.*

G. P. THOMSON: *The Scattering of Hydrogen Positive Rays and the Existence of a Powerful Field of Force in the Hydrogen Molecule.* Communicated by Sir J. J. Thomson, F.R.S.

H. D. SMYTH: *A new Method for Studying Ionizing Potentials.* Communicated by Sir Ernest Rutherford, F.R.S.

I. BACKHURST: *Variation of the Intensity of Reflected X-radiation with the Temperature of the Crystal.* Communicated by Sir William Bragg, F.R.S.

S. DATTA: *The Absorption Spectrum of Potassium Vapour.* Communicated by Prof. A. Fowler, F.R.S.

K. R. RAMANATHAN: *The Molecular Scattering of Light in Vapours and in Liquids, and its Relation to the Opalescence observed in the Critical State.* Communicated by Dr. G. T. Walker, F.R.S.

THE OPTICAL SOCIETY.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, SOUTH KENSINGTON, S.W.7.

THE HISTORY OF THE PHOTOGRAPHIC LENS.

The third of the series of lectures dealing with the evolution and development of optical instruments will be delivered at the Imperial College, at 7.30 p.m., on Thursday, 9th November, 1922, by Dr. R. S. Clay.

Subject: *The history of the photographic lens.*

The lecture will be illustrated by a number of lenses of historic interest.

Discussion on *Spectacles and spectacle construction.*

PRELIMINARY NOTICE.

At a meeting of the Society to be held on the 30th November, 1922, a series of papers will be presented dealing with spectacles and spectacle construction. Fellows and members desiring to contribute to the discussion are invited to communicate with the librarian, Mr. J. H. Sutcliffe, O.B.E., Clifford's Inn Hall, E.C.4. or with the "Papers Secretary" at 50, Bedford Square, W.C.1.

F. F. S. BRYSON.

Joint Hon. Secretary.

MINERALOGICAL SOCIETY.

ANNIVERSARY MEETING, HELD ON TUESDAY,
NOVEMBER 7, 1922.

Papers were read by:—

W. A. RICHARDSON: *The frequency-distribution of igneous rocks in relation to petrogenic theories.*

MISS NAGGS: *Crystallography of organic compounds.*

DR. G. T. PRIOR: *The meteoric iron of Karee Kloof, Cape Province, and the meteoric stone of Leeuwfontein, Pretoria, S. Africa.*

THE SOCIETY OF DYERS AND COLOURISTS.

MANCHESTER SECTION.

The second meeting of the Manchester Section of the Society of Dyers and Colourists for the session 1922-1923, was

held at the College of Technology, Manchester, on Friday, October 27th.

Prof. Knecht presided.

"A Hydroxy-stearic acid and some of its derivatives," by L. G. RADCLIFFE, M.Sc.TECH., F.I.C., and W. GIBSON, M.Sc.TECH.

This paper was a continuation of one published in March, 1920, in the Journal of the Society of Dyers and Colourists, under the title, "The action of Nitric Acid on Saponifiable Oils," by one of the authors and C. Polychronis.

In this paper it was stated that upon the experiments recorded therein it appears that the action of nitric acid on various oils varies according to the nature of the fatty acids which enter into their composition. It was pointed out that with the saturated fatty acids there was little action in the cold with even 99 per cent. fuming nitric acid, but that the hot nitric acid caused oxidation, and in the case of stearic acid, Isonitro-stearic acid was found among the other oxidation products. In the case of the unsaturated acids such as Oleic acid, ordinary nitric acid reacts in the cold, but the reaction takes place very slowly, whereas fuming nitric acid reacts much more vigorously, and even at quite low temperatures yields a nitrated product.

The paper referred to some former work on the sulphonation of oleic acid, which resulted in the formation of hydroxy-stearic acid, and then went on to detail experiments having for their object the determination of the chemical composition of various products formed by the action of nitric acid on pure hydroxy-stearic acid. The earlier part of this work was the preparation of hydroxy-stearic acid itself and a number of characteristic derivatives.

The starting point for the hydroxy-stearic acid was an oleic acid of about 93 per cent. strength, which by treatment with sulphuric acid, as described in a previous paper, gave rise, after the product of the first reaction was treated with water, to the hydroxy-stearic acid melting at 85° C. The composition and properties of this hydroxy acid corresponded to those recorded by previous workers. From this acid the authors have prepared, for the first time, the methyl ester of hydroxy-stearic acid in the form of white flakes, melting at 46° C. Further, the ethyl ester

melting at 48.5°, and an acetyl derivative, melting at 32°C., were made, but all attempts to benzoylate the acid failed to yield a derivative in a state fit for analysis.

A study of the interaction of Bromostearic acid and silver nitrite was described, having for its object the preparation of true nitro compounds of stearic acid. Many experiments were detailed, with references to the work done by other investigators, and as a conclusion it was stated that no such nitro acid could be obtained, and a similar failure took place when silver nitrate was used. In every case the reaction proved to be not a simple double decomposition, and the products did not contain nitrogen.

The views previously set forth by Sender were confirmed, and only the more or less impure alpha-hydroxy-stearic acid resulted.

Later, the action of nitric acid on hydroxy-stearic acid was dealt with, and a fine yellow crystalline compound was obtained, having a melting point of 82°C. This compound was an acid, and from it a number of derivatives were prepared and analysed, but the authors had obtained contradictory results which at the moment cannot be so far reconciled as to enable them to construct a constitutional formula for this yellow compound. One thing, however, was quite certain, that the substance did not contain nitrogen, and in this connection some interesting experiments were described, showing how the ordinary method of analysis was liable to show the presence of nitrogen when in reality no nitrogen was in the compound. In this connection reference was made to a paper published by the United States Bureau of Mines on the determination of nitrogen in coal by Fildner and Taylor, who showed that both fine and coarse copper oxide, when partly reduced and re-oxidised in air retain nitrogen which is not completely removed at room temperature by evacuation and replacement with carbon dioxide. Such an oxide gave considerable quantities of nitrogen when heated alone, as in the Dumas method for the determination of nitrogen.

It was concluded that the errors which had occurred were explained by this research, and the absence of nitrogen in the yellow compound was further confirmed by the usual qualitative tests. The yellow crystals were studied in some detail, and prove to have a molecular weight, by the

Landsberger-Walker-Lumsden method, of the order of 276, while chemical methods based on the supposition that the acid was monobasic gave quite different molecular weights. Other usual methods gave such varying results that no definite conclusions could be come to, though from the analysis of various salts a molecular weight of 291 appears to represent the acid. The esters, such as the methyl and ethyl, were made and described, but it was explained that as one of the authors was obliged to discontinue the work it has been presented in this unfinished state.

The authors conveyed their thanks to the Society of Dyers and Colourists, from whom a monetary grant had been made which had rendered the work possible.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

PASS LIST OCTOBER EXAMINATIONS, 1922.

The following candidates have passed the examination of the Associateship in General Chemistry:—

Chignell, Guy, B.Sc. (Lond.), University College, Southampton; French, Herbert, Heriot-Watt College, Edinburgh; Wild, Francis Eric, B.Sc. (Birm.), Birmingham University; Young, Edward Bernard, B.Sc. (Lond.), East London College.

In Branch (d) Organic Chemistry (under regulations in force prior to March, 1920):

Baguley, Noel Gregory, University College, Nottingham; Cole, Frederic, University College, Nottingham.

GENERAL NOTES.

MINISTRY OF AGRICULTURE AND FISHERIES.

AGRICULTURAL EDUCATION IN ENGLAND AND WALES.

The Ministry makes grants in aid of the higher agricultural education provided at University Departments of Agriculture and Agricultural Colleges in England and Wales.

In addition, most of the counties of England and Wales provide agricultural education of a less advanced character, either through a permanent staff of instructors or through instructors attached to one of the Colleges referred to above. In many cases both systems are adopted.

The Ministry makes grants in respect of this work.

Briefly, the agricultural education now available consists of courses at various Colleges extending over two or more years and leading up to a degree or diploma; shorter courses at the same institutions; courses varying from a few weeks to a year at farm schools and similar institutions; courses of ten days or a fortnight in dairying at migratory dairy schools which visit a number of different centres each season; and courses of day or evening lectures, accompanied in many cases by practical instruction in agriculture, poultry-keeping, bee-keeping, farriery, horticulture and manual processes. Most County Councils offer scholarships, tenable at agricultural institutions or courses, to students resident in the county.

A number of counties carry out field experiments or demonstrations, and have fruit-growing stations, demonstration gardens or trial allotments.

It is not possible within the limits of this leaflet to give particulars of the activities of each county, but a short account of the work of each Collegiate Institution and Farm Institute is given below. *Persons wishing to obtain further particulars should apply to the Secretary or Principal of the Collegiate Institution in question, or in respect of Farm Institute or County work, to the Education Secretary or Agricultural Organiser at the County Council Offices.*

Before taking an institutional course it is very desirable—and in some cases an essential requirement for admission—that the student should have had some practical experience of farm work. Students who have not been brought up on the land are, therefore, strongly advised to spend at least a year on a well-managed private farm where they would have an opportunity of familiarising themselves with the routine seasonal operations. If a suitable farm for the purpose cannot be found by private enquiry it might be well to consult the advertisements or farm pupils which appear from time to time in the leading agricultural papers; or application might be made to one of the County Agricultural Organisers, who may be able to recommend a farm where such facilities are offered.

DEPARTMENT OF OVERSEAS TRADE. EGYPT.

Tenders Invited: Wood Naphtha and Tierol.

The Egyptian Customs Administration invite tenders for the supply of the following:—

130,000 kilos of wood naphtha (wood spirit).

5,000 kilos of tierol
for denaturing ethyl alcohol.

Sealed tenders addressed to the Director-General of Customs, will be accepted at the Office of the Chief Inspector of the Customs Administration, Alexandria, up to noon on the 6th January, 1923.

A copy of the specification for each of the above mentioned commodities may be seen by United Kingdom firms on application to the Department of Overseas Trade (Room 53), 35, Old Queen Street, London, S.W.1.

Local representation is essential, and the Department will be pleased to suggest the names of agents who are prepared to act on behalf of United Kingdom firms not already represented. (Reference 9321/FE/CP).

NOTICES OF BOOKS.

The Nitrogen Industry, by J. R. PARTINGTON, M.B.E., D.Sc., and L. H. PARKER, M.A., D.Sc., F.I.C. Pp. XV. + 336 + 19 plates. London: Constable & Co., Ltd., Orange St., Leicester Square, W.C. 1922. Price 21s. net.

It is now some years since the late Sir William Crookes endeavoured to draw attention to the important question of the future supplies of nitrogenous fertilisers in his book, *The Wheat Problem*.

The authors of the present volume again press forward an urgent claim for the careful consideration of this matter by those in authority.

In the preface they draw attention to the dangers which attend a policy of dependence upon foreign supplies of nitrate, which are so necessary for agricultural purposes, and the manufacture of dyes and explosives.

The fixation of atmospheric nitrogen has become an imperative necessity, and the matter needs to be pursued until the most successful conditions and results have been attained.

The various processes of fixation are described in an interesting and informative way. Whilst being quite sound and scientific, the book is suitable for non-scientific

readers whose interest in this subject is most desirable.

Part I. deals with nitrogen products and Chile nitre. In Part II. the manufacture of ammonium sulphate from the ammonia of the gas-works is described. Part III. is concerned with the fixation processes, and includes an account of the methods for making synthetic ammonia, cyanamide, the arc processes, and lastly (perhaps most important of all) the oxidation of ammonia.

The subject is treated in a very practical manner throughout, and valuable technical and statistical information is presented in a convenient and striking form. The illustrations are also very good.

The book should be read not only by chemists, but should be brought to the notice of the educated and intelligent sections of the general public. To this end, chemists should endeavour to see it placed on the shelves of as many libraries as possible. J.G.F.D.

The Riddle of the Rhine, by MAJOR LEFEBURE, published by W. Collins & Co., Ltd., contains the following interesting foreword.

BY MARSHAL FOCH.

(Translation).

By the year 1918 great strides had been made in the development and use of chemical warfare by the Allied armies. Germany, by means of her pre-war chemical organisations had been able to develop rapidly the large scale manufacture of chemical products used on the front. The same factor was largely responsible for her great progress in this new form of warfare.

The Allies, in self-defence, were compelled to investigate the new method of making war, and to organise huge factories to produce the required chemical munitions. Only by this means, and then with great delay, were they able to meet the growing needs of their armies.

The carrying power of the aeroplane is increasing. Improvements are made almost daily, enabling greater and greater weights to be carried. These developments introduce an entirely new method for the large scale military use of poison

gas. By the use of bombs, which are becoming increasingly efficient and of greater capacity, not only have armies become more vulnerable, but the centres of population situated in the rear, and whole regions inhabited by civilians will be threatened.

Chemical warfare thus acquires the power to produce more terrible effects over much larger areas.

In addition, it is an unchallengeable fact that these developments can materialise most rapidly and effectively in Germany. This country, devoted in times of peace to the large scale manufacture of chemicals, can, by a simple modification in the processes of the industry, transform its peace products into those of war.

But Germany, deprived partially at least of its former armament and means of making war, of its innumerable carefully trained soldiers, well-organised and strongly armed, may well be tempted to develop the new methods of attack provided by chemical warfare.

If, then, we wish to avoid disastrous surprises, chemical warfare must necessarily enter into our forecast of the future, and our preparations for it.

Major Lefebure's book gives a clear idea of such possibilities as they exist to-day in Germany. It reveals the menace of these dangers. All those who have the interests of their country at heart will regard the book as a warning, and as a source of information of the first importance. They will give serious thought to their national position in view of the changes in armament, the present forms of which, through industrial progress, are daily becoming obsolete.

This is a dual note of warning, for, in sounding it I have by my side my good friend, Field-Marshal Sir Henry Wilson. This is indeed in keeping with the past, a practice forged by the intercourse of many years. In another common effort towards the maintenance of peace, we issue this warning for the future.

This, then, is our joint advice—read Major Lefebure's book. F. FOCH.

CUPRAMMONIUM SULPHATE.

BY GEOFFREY N. RIDLEY.

Cuprammonium sulphate is an interesting compound from the point of view of the peculiar attachment of the ammonia. Its formula is $\text{Cu}(\text{NH}_3)_4\text{SO}_4$; this article chiefly concerns the four molecules of ammonia.

That the ammonia is connected with the copper sulphate cannot be denied, but a true double sulphate is not formed. This can be inferred from the weak nature of the ammonia attachment. Thus a few drops of dilute mineral acid added to the blue solution are quite sufficient to destroy the cuprammonium sulphate, by extracting the ammonia to form a true ammonium salt. That such an action takes place is without doubt, for ammonia gas ceases to be evolved when the liquid is heated after treatment. Furthermore, the addition of acid produces a series of changes identical to those created in the preparation of the cuprammonium sulphate, but in the reverse order. Thus the light blue precipitate is first thrown down (the fine blue colouration being removed at the same time), which readily dissolves, leaving a pale blue liquid. If this solution containing the ammonium salt is boiled with caustic soda, ammonia is easily detected.

The effect of boiling the solution of cuprammonium sulphate is to drive off ammonia, by degrees, and at the same time cause a deposit of cuprous oxide to be formed, which becomes converted into black cupric oxide. A little heat applied to the solid compound drives off ammonia rapidly, leaving a greenish blue residue of copper sulphate.

The predominant observation from all these tests is the weakness of the connection by which the ammonia is attached to the copper sulphate. True, ammonium salts are comparatively unstable and easily dissociated, but if the ammonia in the cuprammonium sulphate is attached in the normal way, i.e., ammonium sulphate, dilute sulphuric acid should have no effect on it. But it has been found that the addition of acid destroys the cuprammonium compound entirely. It is therefore supposed that the ammonia is not combined directly with the acid radicle. The ammonia can only be connected with the sulphate through the copper which it probably attacks when the metal is in the form of the hydroxide. An unstable aggregate of copper and ammonia is produced which

is most conveniently called cuprammonium. In the light of experimental results, this seems to be the only satisfactory way of accounting for the behaviour of the ammonia when associated with copper sulphate.

Similar experiments with the nitrate of cuprammonium yield similar results.

Both the sulphate and the nitrate are crystalline, the sulphate crystallising in long, dark blue prismatic (?) forms.



This list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 27305—Barnard, C. M.—Process for manufacture of benzidine. Oct. 9.
 27828—Howes, F.—Process for manufacture of lead arsenate. Oct. 13.
 27560—Kammermann, G.—Apparatus for extraction of oils and greases from vegetable substances. Oct. 11.
 27826—McDagall, I.—Process for obtaining alkaloïds or their salts. Oct. 13.
 27608—Metals Production, Ltd.—Recovery of lead from lead sulphate. Oct. 11.

Specifications Published this Week.

- 186457—Fierz, Dr. H. E.—Apparatus for the manufacture and production of nickel from nickel-carbonyl.
 186458—Fierz, Dr. H. E.—Manufacture and production of metallic nickel from nickel-carbonyl and apparatus thereof.
 186517—British Dyestuffs Corporation.—Manufacture of basic dyestuffs possessing affinity for unmodified vegetable fibres.
 186515—British Dyestuffs Corporation.—Manufacture of 1-4-naphthol sulphonic acid.

Abstract Published this Week.

Delivering Definite Volumes of Liquids.—Patent No. 184826.—A useful fitting for laboratories is an apparatus for delivering definite volumes of liquids into test tubes, invented by Mr. E. E. Glynn, of Thompson Yates Laboratories, The University, Liverpool.

The apparatus comprises a battery of cylinders provided with nozzles and plungers connected by universal joints to means for depressing the plungers through definite distances. In one form the plungers are connected to a bar adapted to be moved by nuts and screws operated by worms on a shaft of a crank. A spring pin carried by the crank engages successively a series of equidistant holes in a fixed disc. The syringes deliver into test tubes carried a stand provided with rollers engaging guide-rails, so that the several rows of tubes may be filled by sliding the stand under the nozzles. The cylinders may be filled from a trough having a longitudinal groove into which the nozzles dip, the trough being held in place by a spring-pin.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

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SOCIETY OF CHEMICAL INDUSTRY.

BIRMINGHAM AND MIDLAND SECTION.

A dinner in connection with the Birmingham and Midland Section of the Society of Chemical Industry was held on Saturday, Nov. 4, at the Queen's Hotel, Birmingham, Dr. E. B. Maxted presiding over a large and representative attendance of Midland chemists.

Mr. F. R. O'Shaughnessy, who was honorary secretary of the Section for 17 years, and who was largely responsible for its re-formation, recently retired, and to mark their appreciation of his services, the members presented him with a valuable laboratory microscope, complete with accessories, and an illuminated scroll signed by the members; and to Mrs. O'Shaughnessy, an opal and diamond cluster ring. These presents were formally handed over by Dr. E. F. Armstrong, the President of the Society. The toast of Mr. and Mrs. O'Shaughnessy was honoured on the motion of Mr. H. Silvester, who testified to the late hon. secretary's tact, efficiency and public spirit. Reviewing the history of chemical organisations in Birmingham, he pointed out that the Society of Chemical Industry was founded in 1880, and shortly afterwards the Birmingham Section was formed. It remained in existence, however, for only a short period. Sir William Tilden then started a new society, called the Birmingham Chemical and Metallurgical Club, which met at the White Horse Hotel, and after dinner discussed contributions on chemical subjects. Later, it removed to the Woodman Hotel, where light refreshments took the place of the dinner, and then Mr. O'Shaughnessy intervened. He pointed out the great disadvantage they were under in that publicity was not given to the discussions, and on his suggestion, the Birmingham and Midland Section of the Society of Chemical Industry was again formed. So that really, Mr. O'Shaughnessy was the cause of the downfall of the Birmingham Chemical and Metallurgical Club. That club left a memorial of its existence in a gift of £10 to the library of

the Chemical Dept. of the Birmingham University, where the Midland Section of the Society now held their meetings. Professor P. F. Frankland, of the University, was the first President, and Mr. O'Shaughnessy the first hon. sec. Mr. Silvester pointed out that it would have been far easier to have started an entirely new society than to have created one from another organisation, but that was done, thanks largely to Mr. O'Shaughnessy; year after year he had secured a good programme of papers, which was no easy matter, having regard to the many other technical organisations, and during his period of office 175 papers were contributed to the Midland Section, and the bulk of them had appeared in the Journal of the Society. Mr. O'Shaughnessy had also organised the general meetings—in 1907 and 1917; and in addition arranged various meetings with other societies and visits to works.

Dr. Armstrong paid tribute to Mr. O'Shaughnessy's work, and to the splendid services rendered by the secretaries of local sections. The discoveries Mr. O'Shaughnessy had made had enriched chemical science, and had benefited the public; his hope was that the microscope would enable him to amplify his discoveries, particularly in relation to the scientific treatment of sewage, and help the world more than he had done.

Mr. O'Shaughnessy fittingly acknowledged the gifts, which his wife and himself would always highly value. He pleaded for the introduction of more of the social element into the doings of the Society.

Responding to the toast of the "Society of Chemical Industry," proposed by Mr. E. C. R. Marks (Mechanical Engineers' Institution, Birmingham Section), Dr. Armstrong, whose name was coupled with the toast, said what he desired to tell them was that the Society of Chemical Industry had a very definite policy. Their policy this year had been to put the chemical profession in a position they thought it ought to occupy—on a par with that of the lawyer, the doctor, and the engineer. The latter, who was perhaps more akin to the chemist, had learnt the necessary lesson: (1) of sticking together, and (2) the value of publicity. "We chemists have within the next few years," he said, "to make up our minds whether we are

going to rehabilitate ourselves as a profession, or whether we are content to remain in the wilderness, and I think it is my duty to go to the sections and preach this doctrine. We have to do all we can to enhance the status of the profession, and to cultivate professional etiquette." (Hear, hear.) He was particularly glad to hear Mr. O'Shaughnessy tell them that they must cultivate the human side. If they did not recognise their faults they could not get right. By all means let them, as chemists, do all they could by practice and research for the benefit of the chemical industry and of the world, but concurrently with those efforts let them be men of broad outlook, ideals, and ambitions, and cultivate the human side in themselves. That must be done if chemistry were to attain the position they desired it to reach. (Hear, hear.)

Professor Ling (Birmingham University) proposed the toast, "The Guests," and Mr. Smout (Birmingham Metallurgical Society) replied, pointing to the importance of chemistry in relation to metallurgy, and expressed the belief that the latter was coming back more to basic principles—to chemistry.

Dr. Maxted hoped the meeting would mark the beginning of a long series of annual dinners.

CHEMICAL AND PHYSICAL SOCIETY, UNIVERSITY COLLEGE, LONDON.

On Tuesday, Oct. 17th, at the first meeting of this session, Prof. J. C. Drummond, this year's President, chose as his subject, "Cod-liver Oil." At the outset, he mentioned that his choice of subject was due to a desire to set before the meeting a typical bio-chemical research which, as he showed later, extended from purely chemical to definitely biological aspects.

Cod-liver oil, he said, was a known and proved remedy of remote ages in Norway, and in China early records show its use in an attempt to combat eye disease in children, with apparent success. Coming to modern times, the growth of chemical and medical knowledge began to be applied to the discovery of the therapeutic agent in cod-liver oil. Three theories existed to account for this and similar cases (a) the Iodine theory, where the

cause was ascribed to Iodine, probably in combination; (b) the Amine theory, introducing the known merits of amino-acids; (c) the Unsaturated Acids theory, which are useful by reason of their easy digestibility.

The great enlightening discovery was that of Vitamines in 1912, by Hopkins, and this was followed by the work of American investigators on certain animal oils.

The lecturer emphasised the extremely minute amounts necessary to restore normal growth in an animal suffering from rickets, 2 mgms. of cod-liver oil being sufficient, and of this, 98 per cent. is known to be glycerides of no anti-rachitic value.

Coming to the reasons for its efficacy, Dr. Drummond described his work with the expedition to Norway, sent by the British Medical Council to establish the reason why the crude oil of 30 years ago is richer in Fat-Soluble A than the modern product. With the aid of lantern slides, he showed the historic method by crude fermentation of cod-liver in open vats, yielding the red-brown oil familiar to older generations. While this method is nearly extinct, the modern process of steam heating, either by direct or indirect application, is by no means well conducted from an hygienic point of view, only one factory being run on any scientific lines.

The party's examination brought out the astonishing fact that the fermentation by the old or new process, and the simple freezing-out methods of refining the crude oil showed no loss of vitamine products, but that there was a seasonal variation in quality. It was, therefore, decided to investigate the life-history of the cod from the point of view of vitamine conservation. The results were remarkable.

Along the coast of Norway runs a northward stream, ending in the Behring Sea, and it was found that the cod came south against this stream in the spring to find suitable spawning grounds. The fish prefer shallow sand-banks, and such places are rare. There are two off the coast of Norway, the Romsdal and Lofoten Islands banks, and here the cod reproduces. The number of spawn is tremendous, and the loss of so much energy causes a large diminution in the vitamine content of the oil obtained at this season. The "normal

dosage" at such times rises to as much as 20 mgms., instead of 2 mgms. in the best products.

The immature cod is carried north by this stream to the region about Fimmar-ken. Their arrival coincides with the sudden remarkable growth of marine plants, diatoms, rich in vitamins, which, at the coming of the sun, fill the sea until it looks like a muddy pond. On these plants feed microscopic marine animals of all sorts, such as "Calanus" of the lobster family. These in turn are food for a slightly higher order of animal, and so on until the small fish forming the chief food of the young cod yields a meal very rich in the "Fat-Soluble A" factor, the essential vitamine of cod-liver oil. It is here that the later season of cod fishing occurs which gives rise to an oil whose normal dosage is only 2 mgms.

Dr. Drummond showed a specimen of the Fat-Soluble A which had been synthesised by the microscopic animal "Calanus" taken from the sea at Plymouth, when immersed in a solution of purely inorganic materials.

Finally, the lecturer described the chemistry of the vitamine. It is not, as popularly supposed, very unstable, as is shown by its survival after the saponifiable matter has been removed from cod-liver oil by boiling in alcoholic potash for 24 hours. This saponifiable matter, 2 per cent. of the whole, is golden yellow in colour, and definitely crystalline. From this can be obtained 30 per cent. Cholesterol, while repeated fractionation of the residue gives, among other products, a small quantity of cetyl alcohol. The pigmentation is probably due to a lipochrome, similar to carotene, the colouring matter of butter.

Dr. Masson, in moving a vote of thanks to the lecturer, suggested that in a few years' time, the sick child would be strengthened by a soup of animalcules rich in vitamins.

In his reply, the President said that such was almost an accomplished fact. He was informed by Dr. Macklin, of the "Quest," that on a previous expedition in the Antarctic, an excellent soup had been made from sea-water which was thick with these microscopic animals.

F.C.R.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION I.—PHYSIOLOGY.

THE EFFICIENCY OF MAN AND THE FACTORS WHICH INFLUENCE IT.

ADDRESS BY PROF. E. P. CATHCART, M.D.,
D.Sc., F.R.S., PRESIDENT OF THE SECTION.

(Continued from Page 283).

The study of the metabolism has given little or no clue so far. Benedict and I carried out a certain amount of experimental work on this phase of the question. Our results show that the subject may be on the very verge of absolute collapse, and yet, so far as the metabolic determination goes, there is no very marked evidence of diminished efficiency in a mechanical sense. In an experiment with M.A.M., who, in the postabsorptive state, rode on a bicycle ergometer for nearly four and a-half hours until on the verge of collapse, doing 208,000 kilogrammetres of external work during the time, the metabolism was determined six times during the riding period with the following result:—

TABLE II.

Time.	Oxygen Consump- tion per min. in cc.	Rate of Work Revs. per min.	Net Efficiency in per cent.
8.30 a.m. (start)			
9.00 a.m.	1.967	91.3	23.1
9.45 a.m.	1.946	91.4	23.3
10.30 a.m.	1.969	91.7	23.2
11.15 a.m.	1.948	90.3	23.2
12.00 noon	2.003	89.0	21.7
12.45 p.m.	1.899	78.2	21.3

It will be noted, as might be expected, that there is some slowing of the rate at which the work is done, but the diminution in the net efficiency, in spite of the fact that the subject admitted he was completely done at the conclusion of the last determination, is not striking.

In other experiments where the type of muscle activity used was marching, little apparent effect on the metabolic cost was noted until extraneous muscle activity was introduced in the form of staggering as the result of exhaustion.

Obviously, then, the capacity to carry on is limited by the genesis of fatigue. But it is equally obvious in practice that a man may be engaged in strenuous labour for many hours without acute signs of impending exhaustion. How is this condition attained? There are at least four factors which, to my mind, play predominant rôles in the attainment of maximum efficiency, viz., the rate of the performance of work, the amount of rest offered or taken by the subject, the rhythm with which the work is performed, and the work habits developed by the worker. Although I shall attempt to examine each of these factors separately, it is not to be inferred that they can really be considered as independent phenomena. As a matter of fact, they are all intimately related, and usually merge into one another.

Of these four factors, probably most attention has been devoted to the rate or speed at which work is carried out. The

glorification of that much misused half-truth, "Time is money," is responsible for much false physiology. Farmer, in a recent report to the Industrial Fatigue Board, laid, I think, the correct stress on the relation of speed to general industrial efficiency when he wrote: "No movement can be compared with another and said to be better than it merely on account of its speed; it should only be compared in respect to ease and final result." This is a good answer to those who believe that maximum efficiency can be best obtained by mere speeding up. Goldmark also stresses this aspect of the question. She writes: "Now just in proportion as this function of speed is developed, subject to the capacities of the human agent instead of as a driver of these capacities, it counts as a gain. Just so soon as the function of speed is dissociated from its effects on the worker we revert to the old system of pace-making and speeding."

These are the observations of field workers. Can they be substantiated by experimental work in the laboratory? Benedict and I found, for example, working with a carefully calibrated bicycle ergometer, that there was a very close connection between the speed at which work was done and the mechanical efficiency. There was a very definite falling off with increased speed, as the following table shows. Unfortunately it was impossible to get our subject to pedal slower than 70 revolutions per minute:—

TABLE III.

Revolutions per min.	Gross Efficiency.	Revolutions per min.	Gross Efficiency.
70	20.6	110	17.6
80	20.0	120	16.9
90	19.2	130	16.1
100	18.4	—	—

We found further that if the amount of effective muscular work done was kept constant, that the efficiency fell with an increase of speed. Thus with effective work equivalent to 1.95 calories performed at the rate of 90 and 124 revolutions per minute respectively with the lower speed, the net efficiency was 22.6 per cent., whereas with the higher speed it fell to 15.7 per cent. Or again, with effective work of 1.58 calories at 71 and 108 revolutions per minute the efficiency was 24.5 per cent. and 15.6 per cent. respectively; and finally, with effective work of 1.35 calories at speeds of 71, 94, and 105, the

efficiencies were 23.1, 20.4. and 17.0 per cent.

A. V. Hill has also recently dealt with this problem in a most interesting piece of work, where the activity was strictly confined to the biceps and the brachialis anticus. He demonstrated very clearly that, in spite of the fact that the slower the contraction the greater was the amount of work done, all the advantage thus gained was rapidly neutralised and dissipated as the result of the slow contraction necessarily causing an increased degradation of energy in the way of physiological changes resulting from the maintenance of contrac-

tion. It thus followed that a slow contraction, powerful though it might be, was not necessarily one of high efficiency. The actual efficiency, *i.e.*, the ratio of the external work done to the energy degraded in carrying it out, was found to pass through a definite maximum value as the duration of the contraction increased. The maximum efficiency in his series of experiments was 26 per cent. He found that it was very rapidly attained, the optimum for the muscles investigated being apparently just under one second, but the fall which followed, as the duration of the contraction increased, was a comparatively slow one. On account, therefore, of the blunt nature of the curve the efficiency remained more or less constant over a wide range of speeds.

The load has obviously a direct connection with the speed at which work is done, but it has also a relation to efficiency. Benedict and I found, for instance, that both the gross and net efficiencies within the limits of our experiments increased with the load. The probable explanation of this result is that when light work is carried out maintenance or physiological requirements which have to be covered form a large proportion of the total energy output, a balance which is steadily altered as the amount of external effective work done increases. Incidentally, Hill drew attention to a most important factor in the

consideration of the efficiency of muscle, *viz.*, the relation between the maximal and the submaximal effort. Hill suggested that the less powerful effort was the result of the maximal contraction of only a portion of the muscle fibres, and that the fibres not directly involved in the contraction changed passively, *i.e.*, they were made to conform to the shape of their active neighbours. This, of course, will automatically lead to a considerable waste of energy in changing the form of the muscle as a whole, therefore the submaximal effort will be less efficient than a maximal effort of the same duration in time, and further "the highest efficiency of a submaximal effort is obtained in a slower contraction than that of a maximal effort."

On the other hand, when the loads become excessive there is a definite falling off, both in gross and net efficiencies. Laulanié, who also investigated this question, found that at voluntarily selected speeds, with steadily increasing load, the external work done rose with decreasing speed until the load became excessive. He maintained that there were two optima, (a) an economic optimum at 4 kilo. load with high efficiency, and a low oxygen consumption per kilogramme, and (b) a mechanical optimum between 8 and 12 kilo. load when the output in unit time was highest. The following table from Laulanié makes his point clear:—

TABLE IV.

Resistance in kilos.	1	2	3	4	5	6	8	10	12	15
Speed adopted, metres per sec.	1.49	1.07	0.80	0.61	0.54	0.44	0.37	0.29	0.24	0.13
Work done, kilogram- mètres per 5 min.	448	642	726	778	812	853	896	905	906	570
Oxygen intake in c.c. per kgm.	3.5	2.44	2.17	2.14	2.23	2.25	2.43	2.53	3.12	5.31
Efficiency per cent. ...	14.1	20.4	22.9	23.3	22.3	22.1	20.4	19.7	17.0	9.4

It will be noted that when the load becomes excessive the efficiency rapidly falls away. This means that, although the effort may be continued as strenuously as before, and although the physiological cost of the effort remains at a very high level, the amount of external work done is reduced to a very low figure. The static element in the muscular effort has become dominant, and static expenditure is parasitic on dynamic work. The more static the work becomes the greater is the fall in the efficiency. Personally I am of the

opinion that the severity or hardness of muscular work, *qua* the organism as a whole, is a function of the static component of the effort made. Fatigue, *i.e.*, inability to carry on, is more readily induced by static work than by either positive or negative work. The following figures from experiments which I have carried out with Miss Bedale and G. McCallum show clearly this diminution in efficiency as the static element in the work is increased:—

TABLE V.

Pulls per min.	Kgm. per min.	Cost in gm. cals. per kgm. p. sq. m.	Net Efficiency per cent.
32	40	16	8.0
12	15	17	7.5
6	7.5	20	6.0
4	5.0	31	3.0+
3	3.75	38	3.0
2	2.5	68	2.0-
1	1.25	146	1.0

Another series of experiments carried out with Burnett in another fashion led to the same conclusion.

Very closely allied with the rate of working is the rhythm with which the work is performed. Although they are not identical phenomena, they are so closely related that the habit of work may be considered along with the rhythm. Sir Charles Sherrington and Graham Brown have both shown very definitely, in connection with their work on reciprocal innervation, that a rhythmic phenomenon may be evoked in muscle by the appropriate balance of antagonistic stimuli. Graham Brown holds that this rhythmic action is one of the most fundamental properties of the nervous system. Everyone is well aware that once a rhythm, or the proper co-ordination in the play of a set of muscles in the performance of some definite act, is mastered, not only is the energy expenditure reduced by the exclusion of numerous extraneous muscular activities, but there is an actual enhancement of the ease with which we perform the specified act. Willingly or unwillingly, those who have to do

much repetitive work, be it playing golf, a musical instrument, or working a machine, soon appreciate the fact, when they think about it at all, that their best and easiest results are obtained under certain very definite conditions. To take a single example, the work of forward progression or walking is performed most easily when we adopt our own gait. It is not a mere question of rate. In a series of experiments which I carried out with Burnett, the subject, working on a specially geared ergometer, was allowed to select his own rate of working, the load being varied from nothing to 4 kilos. At each change of load the subject was directed either to work rapidly or very slowly, and after a period of such work was told to adopt the rate he liked best. As the following table (Table VI.) shows, the rhythm of work was practically identical for all loads. This occurred under all conditions, provided the working spells were not of too long duration. If the work were continued over a long period, the rhythm tended to alter, to increase in speed, and if the subject became really tired, periods of rapid movement alternated with periods of slow movement.

TABLE VI.

Load in kilos.	Rate of Work per min. voluntarily selected.				
	Exp. I.	Exp. II.	Exp. III.	Exp. IV.	(Immediately
0	78	80	83	—	after 1 hour's
1	80	79	79	71	work at rate
2	81	80	81	—	of 45 per
3	80	78	83	73	min.)
4	82	77	78	—	

The figures given are the averages of three or more observations made at each load. None of the observations were made

in the order in which they are recorded; light and heavy loads were alternated.

(To be continued.)

MINISTRY OF AGRICULTURE AND
FISHERIES.

BENEFICIAL INSECTS.

Introductory.

In their relation to cultivated crops, insects may conveniently be divided into three groups, viz.:—

Pests—those which are harmful, causing by their depredations serious loss to the cultivator and a diminution of the country's food supply;

Neutral or negligible—those which do not directly influence crop production;

Beneficial—those which by predaceous or parasitic habits diminish and keep in check the numbers of the pests.

There is some overlapping between these three groups, but it is generally possible to assign an insect to one or the other.

In considering *beneficial* insects from the cultivator's point of view, it is only possible to deal with certain large groups, various members of which attack and destroy the worst insect pests to agriculture and horticulture. Of these groups, five are outstanding as amongst the very best friends possessed by the farmer, gardener and fruit-grower: they are Ladybirds, Lacewing Flies, Hover Flies, Ichneumon Flies, and Tachinid Flies. Only too frequently these insects are mistaken for foes and destroyed. It is hoped that the brief descriptions of them and short outlines of their life-histories herein given may help towards their wider recognition.

In connection with all of them one point must first be emphasised: Beneficial insects seldom, if ever, exterminate a pest, or extermination of themselves would be likely to follow. The most they do is so to check the pests (which would otherwise breed in colossal numbers) that the damage suffered by crops is reduced to an almost negligible amount. Their work of destruction goes on unobtrusively, and only fails when some influence favours the pest or acts adversely on the parasite, allowing the former to survive in such overwhelming numbers that an effective control no longer obtains. The cultivator himself must then resort to artificial measures of pest destruction, but in doing so he must remember that he is often killing both friend and foe alike. He must, therefore, having once begun, be prepared to continue his spraying

or other measures, and himself carry out the work previously left to Nature.

LADYBIRDS.

Ladybirds are beetles which do untold good by feeding in the adult and grub (larval) stages upon Aphides (Greenfly or "Blight"). Some kinds also feed on Scale Insects, Suckers, or other pests.

The adult Ladybird is well known, and is usually respected by everybody; but in the grub stage, being so very different in appearance and somewhat repulsive to look at, it is by no means so often recognised and frequently falls a prey to the uninformed zeal of the gardener, who complains of Greenfly while he busily destroys perhaps its greatest enemy—the Ladybird grub. The appetite of these grubs is enormous, and they appear to feed almost continuously, 30 to 40 Aphides being devoured with scarcely a pause.

ICHNEUMON FLIES.

Under this popular designation may be included several thousand allied species of insects. They are not flies in the zoological sense, but are all close relations of the bees and wasps, albeit not necessarily like them in appearance. They range in size from extremely minute insects, hardly visible to the naked eye, up to as long or even longer than the Hornet, though less heavily built. They have jaws, long antennæ, and four wings, which are always carried along the back and are small in proportion to the creature with few ribs in the supporting framework. In habit they are very active and energetic. Ichneumons probably comprise (with the possible exception of adverse weather conditions) the most potent of all the forces operating to keep in check an overwhelming increase in other insects—a misfortune which always threatens. They do not achieve this by devouring them outright as the Ladybird does, but are parasitic and lay their eggs in or upon the insects they attack. The Ichneumon grubs then feed upon the juices of their victims and come to maturity in their stead. Practically all the other orders of insects are laid under contribution. It would be quite impossible to enter here fully into the immense activities of Ichneumon Flies; suffice it to say that most of the grubs and caterpillars that destroy cultivated crops are known to be attacked. The dried skins of Aphides containing the

parasitic grub and forming a covering for it, can always be found in considerable numbers. In fact, practically all the more serious pests are destroyed by Ichneumons.

Unlike the Ladybirds and Lacewings, of which the grubs are too frequently destroyed in ignorance, the large group of parasitic insects here called Ichneumon Flies need no special plea for their preservation, for in the early stages they are out of sight or not prominently noticeable, and as adults are active, watchful, and able to take care of themselves.

TACHINID FLIES.

Though Tachinid Flies do immense good in destroying caterpillars, it would be serving no useful purpose to deal with them fully with a view to preventing their destruction, for they can only be recognised by the expert entomologist. Superficially, they are much like the common House-Fly, an appearance which is also shared by several other flies which are troublesome pests. Many species of Tachinid Flies are larger than the House-Fly. A close examination of all would show them to be covered with strong bristles. Their habits are akin to those of the Ichneumon Flies, but the egg or eggs are deposited either upon the skin of the grub they attack or upon its food plant. The resulting maggots eat their way into the interior of the creature and feed there, or possibly in certain cases the Tachinid eggs may be eaten by the grub with its food, and reach its body in that way. The grubs feed within the bodies of their hosts. On becoming full-fed they eat their way out and form a puparia, very much like those of the House-Fly and on emerging from them the flies again deposit their eggs.

These insects are true flies, not like the Ichneumons, which are related to the bees. They possess but two wings, and the mouth is formed for sucking.

HOVER FLIES.

Syrphid Flies, or Hover Flies as they are also called, belong to the true flies, though many present a somewhat close superficial likeness to certain bees and wasps. They, nevertheless, have but two wings and sucking mouths, the main characteristics of their whole order. The Syrphid group is a large one which comprises some pests (*e.g.*, the Narcissus Flies), many kinds which are neutral, and a number which are beneficial to a high degree.

The grubs of the latter, together with the Ladybird and the Lacewing, comprise a trio of voracious devourers of Aphides or Greenfly, and are frequently found in company. There is little danger of the very active-winged adult falling a victim to the destroying hand or foot, though undoubtedly the misguided zeal of the gardener only too often finds vent against his good friend in the grub or maggot stage.

LACEWING FLIES.

Lacewing Flies belong to the same class as the Dragon-Flies, have biting jaws, "feelers" or antennæ, and four wings which, with their many fine supporting ribs, have the appearance of net or lace—hence the popular name of the group. The wings, which are large, are carried flat when at rest against the sides of the body, extending beyond it and obscuring the whole hinder portion. The most familiar members of the group are beautiful green insects with golden eyes. Other species are of the same form, but smaller and a plain brown in colour.

Many Lacewings, when in the grub stage, are sometimes confused with Ladybird grubs, and are not inferior to them in their inexhaustible appetite for Aphides. They may also attack Scale Insects or other pests, and some have the remarkable habit of covering themselves with small pieces of lichen, bark, &c., or even with the empty skins of their victims. All Lacewings are valuable, and should on no account be destroyed.

ARTIFICIAL ENCOURAGEMENT OF BENEFICIAL INSECTS.

Five kinds of insects extremely beneficial to the farmer, gardener and fruit-grower—in fact, to all whose activities take them amongst plants for their cultivation—have been touched upon. The five taken do not exhaust the list, but are chosen as being by far the most important.

Apart from the obvious duty of avoiding their destruction whenever possible, the question naturally arises as to whether beneficial insects can be increased or encouraged artificially. In this connection there are two distinct possibilities: (1) the introduction of new kinds of parasitic insects into countries in which they do not already exist; (2) the increase by artificial means of parasites already established in a country. With regard to the first possibility, it has been clearly demonstrated that

where a foreign pest has been introduced into a country without its parasites, then great good may result if such parasites are brought in and released. Thus, if England is so unfortunate as to be colonised by a foreign insect, one of the methods of defence will be to make sure that all the invader's parasites and diseases are introduced as well. An instance in which this method of pest control has proved a great success is that of the destructive Australian Scale Insect (*Icerya purchasi*, Mask.), which has spread from Australia to other countries. It is difficult to control by artificial means, but is kept down completely by its natural enemy, a Ladybird (*Vedalia cardinalis*, Muls.), which is now introduced to any country in which the Scale Insect obtains a foothold. In the same way Ichneumons have been introduced into America and other countries to combat foreign insect enemies which have already established themselves.

Under these conditions, artificial encouragement of parasites is a proved success, but the case is far otherwise when attempts are made to increase artificially the numbers of a parasite already plentiful. It cannot be said that attempts to his end have been generally successful, and it is only under special circumstances that even hopeful results can be claimed. The most usual condition for success—and no case exists in Britain—is where there are great climatic differences between different parts of a country. Thus, in certain parts of the U.S.A., Ladybirds migrate to the mountains in the autumn, and spend the winter in large colonies, only working down to the low ground again when warmed by the spring weather. Naturally the warm weather first reaches the valleys—while the mountains are still cold—and thus pests, which have spent the winter in the valley, get a start and can breed for a time free from their Ladybird enemies. By collecting the Ladybirds from the hills, where they occur together in millions, they can be brought to the valleys and sold by the pound! They are then released as soon as the pests begin to appear in spring.

A second case in which artificial assistance can be given to the control of pests by parasites is where it is necessary to collect by hand large numbers of the pest. The best instance of this is shown by the Apple Blossom Weevil (*Anthonomus pomorum*, L.), which causes "capped blossom," and is one of England's most serious apple pests. If the capped blossoms are col-

lected before the beetles have emerged, many of the blossoms will contain, not weevils, but an Ichneumon parasite (*Pimpla pomorum*, Ratz.) which has killed the weevil. In the case of one Cambridge orchard, Imms† has shown that as many as 26 per cent. of the destroyed blossoms contained Ichneumons. Now, if instead of burning the collected blossoms, they are placed in a muslin cage, the Ichneumons can all be released and the weevils killed, with the result that far more parasites should be available next year to kill a smaller number of pests. This method of dealing with Blossom Weevil has never been tried in England, but in France, in one case at all events, success is claimed.

Yet another condition favourable to the encouragement of parasites is sometimes found when pest and parasites leave their pupæ at different seasons. In the case of the Gout Fly, for instance, it appears that whereas the fly comes out about harvest time, the parasites remain within their pupæ in the barley, which are threshed out in the drum and appear in the "cavings." If the latter are burned, the parasites only are destroyed, while, if left, they will come out later and assist in controlling the fly.

Lastly, conditions for success may be found in the case of plants grown under glass. If a really destructive parasite of any of the more serious glass-house pests—such as the White Fly—can be discovered, it would pay to keep a stock going to distribute when needed in any infested house. The discovery of the parasite in this case is of course the first step.

These cases are all mentioned to show that while it is necessary to be sharply on the look-out for any means of encouraging parasites, yet, in Britain at all events, the chances are not very many. We can be thankful for the help already given by them, which is inestimable, but we cannot yet manage that they shall do all the work, and artificial control measures are therefore needed.

Nevertheless recognition of Beneficial Insects should be widespread and their destruction avoided whenever possible, for all alike ultimately share the benefits they confer. Without Beneficial Insects cultivation would be impossible.

* See Leaflet No. 15, to be obtained from the Ministry and also included in Sectional Volume No. 2, price 40d., post free.

† (Annals of Applied Biology, Vol. IV., p. 211).

MEETINGS OF SOCIETIES.

THE ROYAL SOCIETY.

THURSDAY, NOVEMBER 16, 1922, AT 4.30 P.M.

Papers read:—

Prof. A. S. EDDINGTON, F.R.S.: *The Propagation of Gravitational Waves.*J. H. JEANS, D.Sc., Sec. R.S.: *The Theory of the Scattering of α - and β -Rays.*Prof. A. P. CHATTOCK, F.R.S., and L. F. BATES: *On the Richardson Gyromagnetic Effect.*P. M. S. BLACKETT: *On the Analysis of α -Ray Photographs.* Communicated by Sir Ernest Rutherford, F.R.S.J. H. JONES: *The Kinetic Energy of Electrons emitted from a Hot Tungsten Filament.* Communicated by Prof. O. W. Richardson, F.R.S.W. WILSON, D.Sc.: *The Quantum Theory and Electromagnetic Phenomena.* Communicated by Prof. J. W. Nicholson, F.R.S.S. MARSH and A. E. EVANS: *On Measurements of Electrode Potential Drop with Direct Current and Alternating Current Electrolysis.* Communicated by Dr. E. H. Griffiths, F.R.S.

A Chinese Chemical Society has been formed in California, with the intention of bringing all Chinese engaged in work in chemistry in America into more intimate relationship professionally and socially.

SOCIETY OF GLASS TECHNOLOGY.

Owing to the General Election falling on Wednesday, November 15th, 1922, the meeting of the Society due on that date will be postponed for one week, and will be held accordingly on Wednesday, November 22nd, in the Applied Science Department, The University, St. George's Square, Sheffield, at 3 p.m.

AGENDA.

1. Minutes.
2. Applications for membership.
3. Award of the "Frank Wood" Medal.
4. The President will speak briefly on "*The Present State of the Glass Industry in Czechoslovakia.*"
5. To receive and discuss the following papers:—

(a) "*The Changes in the Early Stages of the Melting of Glass Batches,*" by MORRIS W. TRAVERS, D.Sc., F.R.S., F.I.C.

(b) "*The Production of Colourless Glass in Tank Furnaces with Particular Reference to the Use of Selenium,*" Part II., by A. COUSEN, B.Sc., A.R.C.S., and Prof. W. E. S. TURNER, D.Sc.

AWARD OF THE "FRANK WOOD" MEDAL.

To mark the services to the Society of Mr. Frank Wood, First President, the Society in 1919 raised by subscription a sum of £105 8s. 6d., which was given to the University of Sheffield to provide a Medal and Prize to be awarded annually to the student who attained the highest standard in the examination for the degree of B.Sc.Tech. in Glass Technology.

The medal has been designed by Mr. Percy Metcalfe, of the Royal College of Art. Copies of it will be on view at the meeting.

By request of the University, Mr. Frank Wood himself will present the Medal to two students who have won it, namely:—

Mr. G. G. Middleton, B.Sc.Tech., in 1921, and Mr. H. W. Howes, B.Sc.Tech., in 1922.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

ORDINARY MEETING, 1ST NOVEMBER, 1922.

Held at the Chemical Society's Rooms, Burlington House, Mr. P. A. Ellis Richards (President) in the chair.

Certificates were read for the first time in favour of:—

Messrs. Henry Aldons Bromley, Robert Faraday Innes, F.I.C., Osman Jones, F.I.C., Alan West Stewart, D.Sc., A.I.C., William Heaton Thorns, Walter Horace Clulow, William Plenderleith Lewellen Hope.

Certificates were read for the second time in favour of:—

Messrs. George Scott Robertson, D.Sc. (Dun.), F.I.C., Frederick John Martin, M.A. (Cantab), A.I.C., Frederick Stanley Shadbolt, A.I.C.

The following were elected members of the Society:—

Messrs. Archibald Steele Whamond, Thomas John Ward.

The following papers were read:—

"*The Colorimetric Estimation of Pyrogallol, Gallotannin and Gallic Acid,*" by C. AINSWORTH MITCHELL, M.A., F.I.C.

"*The Estimation of Narcotine and Papaverine in Opium*," by H. E. ANNETT, D.Sc., F.I.C., and M. N. BOSE, M.A., and "*The Estimation of Codeine*," by H. E. ANNETT, D.Sc., F.I.C., and R. R. SANGHI.

"*The Estimation of Morphine*," by J. R. NICHOLLS, B.Sc., F.I.C.

"*Further Notes on the Estimation of Potassium; By Perchlorate and Cobaltinitrite Methods*," by R. L. MORRIS, F.I.C.

"THE COLORIMETRIC ESTIMATION OF PYROGALLOL, GALLOTANNIN AND GALLIC ACID," BY C. AINSWORTH MITCHELL, M.A., F.I.C.

The author has devised a ferrous tartrate reagent which can be used for the detection and estimation of pyrogallol, gallotannin and gallic acid. The violet coloration produced in the reaction is due to the pyrogallic group in these substances and, applied quantitatively, affords a measure of that group in different compounds. The reaction throws light on the constitution of gallotannin. The results obtained with it do not agree with the long accepted formula for gallotannic acid, or with the formula of Emil Fischer's synthetic gallotannin, but are much more in accordance with the formula recently suggested by Nierenstein, at any rate in the case of tannin from China galls, and they decide a doubtful point in connection with that formula.

In using the reagent for the estimation of gallotannin in the presence of gallic acid the substances are estimated together colorimetrically in terms of gallic acid or pyrogallol. The tannin is then precipitated with quinine hydrochloride and the gallic acid again estimated in the filtrate. The difference between the two results, multiplied by a factor gives the gallotannin. The method has been applied to the estimation of tannin and gallic acid in various natural and commercial products such as galls, tannin extract, myrobalans, divi-divi, tannin lozenges, tea, etc. It has also been used to follow the course of the enzymic hydrolysis of gallotannin, and to study the nature of the changes which occur in the technical process of roasting myrobalans.

"THE ESTIMATION OF NARCOTINE AND PAPAVERINE IN OPIUM," BY H. E. ANNETT, D.Sc., F.I.C., and M. N. BOSE, M.A.

The authors, being engaged in experiments on poppy selection with a view to the production of medicinal opium of high

quality, have found it necessary to devise processes for the estimation of the principal alkaloids of opium, which can be carried out on the very small quantities of the drug (say 1 to 2 grams) obtainable from the few plants produced in such selection experiments. In the case of narcotine and papaverine they have utilised an old observation of Plugge's that on addition of sodium acetate to an aqueous opium extract, narcotine, papaverine, and narceine are precipitated. The authors find that, given the right conditions, the first two are precipitated completely, that the narceine carried down at the same time can be washed away with water, and that in the washed precipitate after further purification, narcotine can be estimated polarimetrically.

"THE ESTIMATION OF CODEINE," BY H. E. ANNETT, D.Sc., F.I.C., and R. R. SANGHI.

This is an improved and simplified form of the process described by Annet & Son in 1920 (*Analyst*, 1920, XLV., 321) in which the codeine is extracted by toluene from an aqueous alkaline extract of opium, converted into the hydrochloride, purified by re-extraction with toluene, and finally converted into hydrochloride and weighed as such.

"THE ESTIMATION OF MORPHINE," BY J. R. NICHOLLS, B.Sc., F.I.C.

If two volumes of 50 per cent. alcohol are shaken with one of chloroform and allowed to separate, the two layers are about equal in volume, the upper being about 33 per cent. alcohol, and the lower having an approximate chloroform-alcohol ratio of 2:1.

If the 50 per cent. alcohol contains morphine liberated by means of ammonia, the base distributes itself between the two layers so that about 85 per cent. of the total morphine is in the lower layer. When this layer is run off the addition of half a volume of alcohol to the upper layer brings it to approximately 50 per cent. alcohol again, and after shaking with 1 vol. of chloroform, the second lower layer contains about 85 per cent. of the remaining morphine. Two such extractions, therefore, remove over 99 per cent. of the base, and in practice 4 extractions will only be necessary to remove more than 0.1 gram of morphine.

The presence of the alcohol retards or prevents the crystallisation of the base from the upper layer, and ensures a rapid separation. The combined extracts can easily be evaporated on the steam bath.

For general application of this method of extraction, other alkaloids are removed by means of ether and chloroform from a suitably prepared aqueous solution made alkaline with sodium, potassium or calcium hydroxide, 1 vol. of the solution is mixed with 1 vol. of alcohol, the fixed alkalinity removed by a slight excess of ammonium sulphate, and the morphine extracted as described.

Small amounts of other substances may also be removed, but these do not interfere with the estimation of the morphine either by titration, or colorimetrically or polarimetrically.

"FURTHER NOTES ON THE ESTIMATION OF POTASSIUM; BY PERCHLORATE AND COBALTINITRIDE METHODS," By R. L. MORRIS F.I.C.

This paper is a continuation of a previous paper by the same author (*Analyst*, 1920, XLV., 349). A modification suitable for the direct estimation of Potash in the presence of phosphates of calcium, magnesium, iron, etc., is described. It is stated that sulphates should always be removed, and a method of precipitating these by barium chloride is put forward which reduces the usual loss of potash in the barium sulphate precipitate to negligible amounts.

Drushel's modification of the cobaltinitride-permanganate process is shown to give trustworthy results, more especially for small amounts of potash, but some experience is necessary. Half saturated sodium chloride solution should be used for the final washing of the precipitate, and sulphates have no influence on results.

THE FARADAY SOCIETY.

ANNUAL GENERAL MEETING, 1922.

The Annual General Meeting, 1922, will be held in the Rooms of the Chemical Society, Burlington House, W.1, on Monday, November 20, at 7.45 p.m.

AGENDA:

1. Receive Report of Council and Accounts.

2. Elect Officers and Council as per nominations already announced.
3. Elect Honorary Auditors.
4. Votes of thanks.

ORDINARY MEETING, 8 P.M.

The following papers will be presented:

"Intramolecular Ionisation," PROF. T. M. LOWRY.

"On the Viscosity and Molecular Dimensions of Hydrogen Selenide," C. J. SMITH.

"The Hydrogen-ion concentration of Natural Waters and Etching Reagents in relation to Action on Metals," W. R. G. ATKINS.

"The Scattering of Light by Organosols and Gels of Cellulose Acetate," E. W. J. MARDLES.

"Studies of the reversible sol to gel transitions in non-aqueous systems," E. W. J. MARDLES.

Contributions to the discussions are invited from members and others unable to attend the meeting.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

ARRANGEMENTS FOR FIRST PART OF SESSION 1922—1923.

Ordinary Meetings of the Institution.

(Thursdays at 6 p.m. Light Refreshments 5.30 p.m.)

30 Nov., 1922: W. A. GILLOTT, "Domestic Load Building; a few Suggestions upon Propaganda Work."

7 Dec., 1922: A. M. TAYLOR, "The Possibilities of Transmission by Underground Cables at 100,000/150,000 Volts."

14 Dec., 1922: J. CALDWELL, "Electric Arc Welding Apparatus and Equipment."

4 Jan., 1923: F. CREEDY, Lecture on "Variable-Speed A.C. Motors without Commutators" (to be followed by a discussion).

18 Jan., 1923: G. H. NELSON, "Works Production."

6 Feb., 1923 (Tuesday): ANNUAL DINNER at the Hotel Cecil (7 for 7.30 p.m.)

DEPARTMENT OF SCIENTIFIC AND
INDUSTRIAL RESEARCH, 16, OLD
QUEEN ST., WESTMINSTER,
LONDON, S.W.1.

TECHNICAL RECORDS OF EXPLOSIVES SUPPLY,
1915-1918.

No. 9. *Heat Transmission.*

A special series of reports is being published for the Department of Scientific and Industrial Research, in order to make available, for the benefit of the industries concerned, results of scientific and industrial value contained in the technical records of the Department of Explosives Supply of the Ministry of Munitions. The preparation of the summaries of information was begun by the Ministry of Munitions at the close of the war, and arrangements were afterwards made for the Department of Scientific and Industrial Research to complete them.

Eight reports of the series have already been published, viz.:

No. 1: Recovery of Sulphuric and Nitric Acids from Acids Used in the Manufacture of Explosives: Denitration and Absorption. Price, 12s. 6d. (by post 13s.).

No. 2: Manufacture of Trinitrotoluene (TNT) and its Intermediate Products. Price, 17s. 6d. (by post 18s.).

No. 3: Sulphuric Acid Concentration. Price, 12s. (by post 12s. 7d.).

No. 4: The Theory and Practice of Acid Mixing. Price, 12s. (by post 12s. 6d.).

No. 5: Manufacture of Sulphuric Acid by Contact Process. Price, 25s. (by post 26s.).

No. 6: Synthetic Phenol and Picric Acid. Price, 15s. (by post 15s. 7d.).

No. 7: Manufacture of Nitric Acid from Nitre and Sulphuric Acid. Price, 10s. (by post 11s.).

No. 8: Solvent Recovery. Price, 3s. (by post 3s. 3d.).

The present report, which is the last of the series, deals with the problems of heat transmission in relation to factory practice, the subject matter being arranged under the following headings:—

Theoretical Section—Fundamental principles, Criterion for turbulence, Determination of coefficients of transmission, Application of method of dimensions, Application of coefficient of transmission to specific problems, Construction of alignment charts.

Experimental Section—Method of investigation, Examination of experimental re-

sults, Acid coolers at Queen's Ferry, Water economy and efficient cooling, Lead cooler in denitration plant, Superheater in denitration plant, On effect of stirring, Surface condensers, Heat interchange in a cylinder in which a heat-producing reaction takes place, Surface loss.

Application of the Principle of Quann's Bubbler-Scrubber to the Cooling of Condensing Water—Amount of air passed through 1 in. diameter hole for various pressure differentials, Velocities or various pressure differentials, Volume of air which will pass through plate, Temperature gradient of water passing over 1 ft. length of plate for various velocities, Air efficiency, Air required to cool 1,000 lb. water per hour, Power required, Summary.

The report is illustrated by diagrams.

Copies can be obtained from the Sale Office, H.M. Stationery Office, Kingsway, London, W.C.2.

DIACETYLACETONE.

By J. N. COLLIE AND MISS A. A. B. REILLY.

These authors show that the reactions of diacetylacetone are not consistent with a triketone formula, or one containing ordinary hydroxyl groups. A ring formula is suggested as possible. Diacetylacetone is prepared by treating dehydroacetic acid with HCl, and removing the excess of the latter by distillation under reduced pressure. The residue is treated with caustic soda solution and barium hydroxide, and the yellow precipitate, on boiling, collected, decomposed with HCl and extracted with CHCl_3 . After recovering the solvent, the residue is fractionated under reduced pressure. On solidification of the distillate a molecular change occurs, as noticed by the alteration in refractive index. The residue in the flask was dissolved out with alcohol as a colourless crystalline mass $\text{C}_{14}\text{H}_{14}\text{O}_3$. Diacetylacetone reacts with phenylhydrazine giving a compound $\text{C}_{19}\text{H}_{20}\text{N}_4$, M.P. 142°C . The semi-carbazone obtained by treating diacetylacetone with a slightly alkaline solution of semi-carbazide hydrochloride was separated as long crystals M.P. 203°C . $\text{C}_7\text{H}_{10}\text{O}_3 + \text{CH}_3\text{ON}_3 = \text{C}_8\text{H}_8\text{ON}_3 + 3\text{H}_2\text{O}$. Several other compounds are also described. (*J. Chem. Soc.*, 1922, CXXI., 1984-1987.)

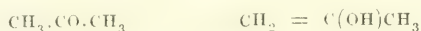
OXIDATION OF ACETONE WITH PERMANGANATE.

By W. L. EVANS AND MISS L. B. SEFTON.

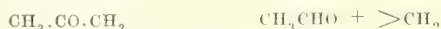
Previous investigators have shown that acetic acid, formic acid, oxalic acid and pyruvic acid may be obtained from the oxidation of acetone, the actual products depending upon such factors as temperature and the oxidation agent used. The present authors have studied the oxidation of acetone with both neutral and alkaline permanganate at varying temperatures. The final products were oxalic acid, carbon-dioxide and acetic acid only. The equations given to express the oxidation are:—



but these do not indicate intermediate stages of the reaction. Again, the amounts of both acids and CO_2 formed were found to vary with temperature and concentration of alkali. Thus, more oxalic acid is produced at high temperatures ($50^\circ\text{--}75^\circ\text{C.}$) and higher alkali concentrations. At 164°C. and in neutral solutions, acetone should be completely oxidised by KMnO_4 to CO_2 only. From consideration of the reaction products it has to be assumed that iso-acetone molecules are present in aqueous acetone.



In neutral solutions, acetone is dissociated into acetaldehyde and methylene



and acetic acid and CO_2 arise from the oxidation of these respectively. Acetol is also an intermediate product.—(*Jour. Amer. Chem. Soc.*, 1922, p. 2276.)

REACTION OF NEUTRAL SALTS WITH CELLULOSE.

By HELEN MASTERS.

The present paper, which gives a general survey of the subject under consideration, draws attention to the fact that when neutral salts in solution are passed through purified cellulose there appears to be some type of reaction taking place. The cellulose used was prepared from good quality cotton wool by washing with freshly distilled water. On passing a neutral solution

of sodium chloride through this wool (cellulose), the former was found to react acid towards methyl orange. Further, on washing the cotton wool with water, the washings were alkaline, and the acid found in the sodium chloride solution was found to be approximately equivalent to the alkali found on washing the wool with distilled water. It is clear that this reaction is not due to any washing out of impurities in the wool, and when the latter was washed to free it from the alkali, and then again treated with a sodium chloride solution, the latter solution again assumed an acid reaction to methyl orange, while the wool was also alkaline. Wool appears to act in the opposite direction, while purified asbestos is inert to sodium chloride solutions. The characteristic behaviour noted is not confined to sodium chloride solutions alone, but is of a general nature with neutral salts. Further experimental work is in progress.—(*Jour. Chem. Soc.*, 1922, CXXI., 2026.)

GENERAL NOTES.

The plate of the Ramsay Memorial Tablet that appeared in our last issue was a reproduction of a photograph by Messrs. Elliott & Fry, Ltd. A certain number of additional copies are available, and can be obtained by application to the office of *The Chemical News*. Price 4d., post free.

We learn from the *Journal of the Canadian Institute of Chemistry* that new buildings for the Western University, London, Ont., which will ultimately cost close upon one million sterling, is shortly to be commenced, and that a contract has been signed for the science buildings and cost £100,000.

PROTECTION OF BRASS WEIGHTS.

In a paper by J. J. Manley, M.A., appearing in the *Philosophical Magazine* for November, details are given of a method originated by Faraday for protecting metals from rust. A set of brass weights were lightly turned and polished, heated in a semi-luminous gas flame until nearly red-hot, and quenched in boiled linseed oil.

They were afterwards washed in turpentine and polished with old linen.

These weights have been in regular laboratory use for 16 years, and are still in good condition.

Attempts to treat other weights in the same way recently, failed to produce the same results, and the failure was found to be due to the sulphur compounds present in modern coal-gas—a modified method was devised that was quite successful.

The weights, after polishing, are evenly covered with linseed oil, and are then supported on some fragments of fused quartz or porcelain in a vitrosol muffle which is closed and heated until the weights assume a "golden tint." After cooling, they are rubbed with an old silk handkerchief.

Weights so protected are said to resemble the appearance of bequered brass.

LITERARY INTELLIGENCE.

Messrs. J. & A. Churchill expect to publish shortly a new work, entitled, "The Theory of Emulsions and Emulsification," by Dr. W. Clayton. The volume has a foreword by Prof. F. G. Donnan, F.R.S. The Second Edition of Dr. J. D. Gimlette's "Malay Poisons and Charm Cures" is nearly ready. For this edition Sir W. Willcox, K.C.I.E., C.B., etc., has written a foreword.

Other volumes which will be published in a few weeks' time are "Applied Pharmacology," by A. J. Clark, Professor of Pharmacology, University College, and the eighth edition of "Tomes' Dental Anatomy," edited by Dr. Marett Tomes and Mr. C. Bowdler Henry.

NOTICES OF BOOKS.

The Manufacture of Dyes, by JOHN CANNELL CAIN, D.Sc. (Manchester). Published by MacMillan & Co., Ltd., London. 1922. Price 12s. 6d.

Unfortunately, death overtakes us all, and does not even wait to allow us to complete the tasks we set ourselves. This was so in the case of the late Dr. Cain, with the result that at the time of his death the work under review was still in manuscript form. We are, therefore, greatly indebted to Prof. J. F. Thorpe for undertaking the task of editing the manuscript and so providing the dye industry with the companion volume to the late author's earlier work, "The Manufacture of Intermediate Products for Dyes."

This book represents an enormous amount of effort and consists of a very readable account of the published information relating to the manufacture of dyes. Like all compilations, the value of the facts recorded depends upon the honesty of the original writers, and as some writers deceive themselves, whilst others intend to deceive, it is possible to discover inaccuracies in some of the statements made; however, in making the above statement it must be confessed that the writer has the advantage of being in possession of information which is unfortunately not available to the scientific world. As a general rule, the longer the period during which a dye has been manufactured, the greater is the tendency for information to leak out of a factory and eventually find its way into the technical literature, and so naturally the most interesting portions of the book are those sections where the leakage has been greatest. Thus the triphenylmethane colours in general, and Magenta in particular, are excellently recorded, whereas in certain other cases the patent literature has been the sole source of inspiration.

A special feature of this book is that it makes the information stored up in such rare books as "Progrès de l'Industrie des Matières Colorantes," Wurtz (1876); "Die Technik der Rosanilin farbstoffe," Mülhhausen (1889); and Harmsen's *Die Fabrikation der Theer farbstoffe* (1889) available to the English dyestuff student in a convenient form.

Actual mistakes appear to be very few, but it appears that, in connection with the dyestuff, Galloeyanine, that an omission has been made, for the remarks commence with the preparation of pure Galloeyanine from the technical product, but no recipe is given for the production of this.

Another omission of a different character is the absence of information for the preparation of the Anthraquinone acid colours, such as Alizarin Cyanine Green.

We are of the opinion that the use of heavier type for the name of the dye at the head of the section in which the compound is described would improve what is already a well-published book. We should also like to suggest that the chemist responsible for the next edition should give the quantities of material used in the different preparations in terms of mols. as well as the actual weights, thereby improving the educational value of the work, and also facilitating the making of comparisons when several recipes are given.

To sum up, the book is a very valuable addition to our own literature of dyestuff chemistry, and should appeal to all organic chemists.

An Introduction to the Chemistry of Plant Products, by P. HAAS, D.Sc., Ph.D., and T. G. HILL, A.R.C.S., F.I.S. Vol. II, pp. VIII. + 140. London: Longmans, Green & Co., 39, Paternoster Row, E.C. 1922. Price 7s. 6d. net.

The authors of this well-known work have taken the opportunity of the appearance of the third edition to rearrange and to enlarge extensively the subject matter in accordance with the very rapid developments which have taken place in this branch of bio-chemistry.

Vol. I., on the Nature and Significance of the Commoner Organic Compounds in Plants, appeared last year, and has already received notice in *The Chemical News*, 1921, CXXIII. (Aug. 26).

Vol. II. has now been issued, and deals with the metabolic processes which occur in plants. It contains a very clear account of the synthesis of carbohydrates and proteins, and the mechanism of respiration and of growth is described in adequate detail in accordance with the latest views on the subject.

Prominence is rightly given to the conditioning factors in all these processes of plant life.

The authors do not claim to have mentioned all the researches in this branch of science, yet they have included much of the recent work of importance. Even the investigations of Baly, Heilbron and Hudson upon the mechanism of photosynthesis are very fully discussed, although they were only published a few months ago in *The Journal of the Chemical Society*.

This third edition will prove to be as valuable and widely consulted as the previous ones. J.G.F.D.

Chemical Reactions and Their Equations, by I. W. D. HACKH, Ph.C., A.B. Pp. 138. London: Chapman & Hall, 11, Henrietta Street, W.C.2. 1922. Price 6s. net.

The inability to give correct equations to represent chemical reactions is a difficulty frequently found among students. This applies especially in the case of ionic equations, and the appearance of Professor Hackh's little book on this subject is very welcome.

The author does not enter into a detailed consideration of the numerous typical and important reactions, but gives a very large number of equations representing the chemical changes with which students are acquainted.

At the end of each chapter are questions which serve as a good test of the student's progress in comprehending this phase of the subject.

Several useful appendices are given at the end. *The Solubility Table* resembles one used extensively and with good results by the reviewer.

The combined index and glossary should also prove useful. J.G.F.D.



THIS list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 27696 Mourgan, G. — Ammonia manufacture. Oct. 12.
- 28225—Chemical Research Syndicate, Ltd.—Conversion of aromatic ring compounds into motor spirits. Oct. 17.
- 28200—Lush, E. J.—Method of activating and re-activating metallic catalysts. Oct. 20.
- 28584—Soc. Anon. La Céramique Nationale.—Apparatus for manufacture of ceramic tiles. Oct. 17.
- 28381—Williams, J. G.—Process for manufacture of salts derivable pyrogenously from metallic ortho-phosphates.

Specifications Published this Week.

- 186635—Society of Chemical Industry in Basle, and Straub, F.—Manufacture of chromium compounds of azo-dyestuffs.
- 167464—Manufactures de Produits Chimiques du Nord Etablissements Kuhlmann.—Mechanically-operated furnaces for roasting pyrites or like ores.
- 186840—Woodlands, Ltd.—Production of hydrogen peroxide.
- 186859—Imray, O. Y.—Manufacture of B-thio-naphtholisin.

Abstract Published this Week.

Ammonia.—Patent No. 185179.—An improvement in the plant for the catalytic synthesis of ammonia has been Patented in this country by Messrs. L. Casale and R. L'Epestre R., 9, Via del Parlamento, Rome. The apparatus is constructed of three concentric tubes, the outer being the pressure tube, the middle one containing the catalyst, and the inner one provided with a heating element; and the disposition of the gas connections is such that the entering gases pass first between the outer and middle tubes, then traverse the inner tube, and are finally conducted through the contact material. By this means, the internal wall of the pressure tube is protected against excessive heating.

Messrs. Rayner & Co. will obtain printed copies of the published specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3267

A GASOMETRIC METHOD OF ESTIMATING THE HALOGEN IN ORGANIC COMPOUNDS.

BY ALEXANDER KILLEN MACBETH.

Some time ago it was pointed out (Baillic, Macbeth, and Maxwell, *T.*, 1920, CXVII., 880) that tetranitromethane was readily reduced by solutions of hydrazine hydrate, and it was observed that the oxidation of the latter reagent involved the quantitative liberation of nitrogen. When the reaction was carried out in a nitrometer, measurement of the liberated nitrogen furnished the basis of a method of estimating the amount of the nitro-compound present in solution. The reaction was extended to the halogen derivatives of nitroform after a new method of preparing these compounds was developed which rendered them available in a pure state (Macbeth and Pratt, *T.*, 1921, CXIX., 354, 1356).

Examination of the different types of organic compounds which contain labile halogen atoms indicates that they may be divided into two classes. On the one hand we have such substances as the acid chlorides which are characterised by the facility with which they undergo hydrolysis, and by the ease with which the halogen reacts with ammonia and with hydrazine to give the corresponding amides or hydrazides. On the other hand, we have substances like chloro- and bromo-trinitromethane which oxidise hydrazine, and do not give a double decomposition reaction with ammonia: compounds of this type are not easily hydrolysed.

If the structures of the different halogen compounds are examined with special reference to the polarities of the constituent

atoms (and especially oxygen atoms in the α -position to the halogen) it is seen that the halogen atom in the two classes referred to differs in electrochemical nature. In the acid chlorides the halogen atom is electro-negative; in chloro- and bromo-nitroform it possesses a ninduced electropositive character (*T.*, 1922, CXXI., 892).

Other compounds containing an "electropositive" halogen atom of this type are also acted upon by reducing agents, and the halogen is quantitatively removed by such reagents as hydriodic acid, titanous salts, and hydrazine. The action of hydrazine has been employed as the basis of a gasometric method of estimating such compounds, and as the method is a very convenient one the procedure may be briefly described.

A van Slyke nitrometer is well adapted for the process, and in the estimation 1 cc. of hydrazine hydrate (50 per cent. solution) is run into the deaminising vessel, the three-way tap being turned to allow the displaced air to escape. The tap is now turned into connection with the graduated column, and 5 cc. of a solution of the halogen compound introduced into the deaminising vessel. The nitrogen is steadily evolved, the time required for the reaction to complete itself varying with the nature of the halogen compound and the strength of the solution. With chloro- and bromo-trinitromethane all the nitrogen is liberated in the course of one minute: with ethyl bromoisosuccinate, the reaction extends over six or seven minutes. The volume of gas in the graduated column is noted when the temperature is in equilibrium, and the volume of solution introduced during the estimation is deducted. Calculation of the weight of nitrogen evolved leads to the amount of halogen (or halogen compound) employed. Acetobromoamide and dibromomalonic ester, for example, react according to the equations,



In the higher substituted chloro- and bromo-malonic esters reduction is very slow and is not complete above the propyl-compound; this is probably due to a steric hindrance effect.

The method has been applied with success to the following compounds, amongst others. Chloro- and bromo-trinitromethane,

dibromodinitromethane, α -bromo- $\alpha\alpha$ -dinitroethane, phenylbromodinitromethane, benzenesulphondichloroamide, chloramine T, dichloramine T, N-chloroacetanilide, acetobromoamide, ethyl bromo- and dibromo-, chloro- and dichloro-malonic esters, propyl bromomalonate, ethylbromoisosuccinate, etc., from which the halogen is completely

removed. It has also been employed with compounds of the type 4-chloro-4-bromo-1:1-dimethylcyclohexane-3:5-dione, and the 1:1 dibromo-compound: cyclohexane-spiro 4-chloro-4-bromo-cyclohexane-3:5-dione and the 4:4 dibromo compound. One bromine atom is quantitatively removed from these compounds by hydrazine hydrate, but the corresponding dichloro-compounds and the monohalogen derivatives are unattacked by this reagent in the cold (see also T. 1922, 121, 904, 1116, 2169).

" ISOTOPES."

A Joint Meeting was held on Friday, November 3rd, of the Manchester Literary and Philosophical Society, and the Manchester Sections of the Society of Chemical Industry, the Society of Dyers and Colourists, and the Institute of Chemistry. The meeting took place in the Textile Institute.

Prof. W. L. Bragg, F.R.S. (representing the Manchester Literary and Philosophical Society) presided over the meeting, which was a very large one.

Mr. F. W. Aston, D.Sc., M.A., F.R.S., of Trinity College, Cambridge, read a paper entitled "Isotopes."

Dalton's atomic theory postulated that atoms of the same element were equal in weight. Beyond mere speculation the first attack on the validity of this wholly unproved hypothesis was made about 1910, when Soddy put forward his theory of Isotopes and predicted the existence of varieties of lead having different atomic weights, a prediction amply verified later. The same possibility was suggested in the case of the non-radioactive elements by the positive ray analysis of Neon. By this analysis one compares the weights of individual atoms, and this can now be done with an accuracy of one part in a thousand by means of the mass-spectrograph. This instrument gives a focussed spectrum depending only on the weights of the particles forming the positive rays, and as these are charged atoms and molecules, their weights can be directly compared. It is found that many, probably the majority, of the elements consist of mixtures of Isotopes. Thus chlorine (atomic weight 35.46) consists of two of atomic weights 35 and 37 respectively. Some of the heavier elements are exceedingly complex, xenon having no less than nine constituent Isotopes. By far the

most important result is that the atoms of all elements except hydrogen have integral weights when expressed on the oxygen scale to a considerable degree of accuracy. This "whole number" rule enables sweeping simplifications to be made in our ideas of mass. All atoms may now be considered simply as different aggregations of primordial atoms. The latter are of two kinds, positive and negative, protons and electrons, the particles of electricity itself. The fact that the elements of fractional atomic weights are mixtures of isotopes of whole number atomic weight explains at once anomalies in order such as the atomic weights of argon and potassium. On Rutherford's Nucleus Atom theory isotopes are elements whose atoms have the same net positive charge on their nuclei (Moseley's atomic number), but different numbers of protons and electrons in these nuclei and therefore different weights. Isotopes have practically identical chemical and optical properties. Their separation is a matter of extreme difficulty, and only the minutest changes of atomic weight have been experimentally achieved so far. The weight of the hydrogen atom is found to be greater than unity, this is of great importance, for if it were possible to transmute hydrogen into any other element prodigious quantities of energy would be liberated. This transmutation is probably going on in the sun and other stars continuously.

THE EDUCATION OF THE CHEMIST.

Dr. O. L. Brady, F.I.C., addressing the Chemical and Physical Society of University College, London, on October 31st, on the "Education of the Chemist," said that the reason why the status of a chemist was not as high as that of other professions, such as medicine or law, was due in a large measure to the incomplete nature of his training. Present-day specialisation has resulted in men, who, although extremely well read in their own branch of science, have no education or interests outside their work. Chemists are not, as a rule, "men of the world," nor are they capable, by reason of their training, of interesting their directors or works-managers. The result has been that rarely does a manager make a personal friend of his chief chemist, solely because of the lack of topics of conversation and general "talk," which all chemists would readily admit is too often

limited to "shop." Consequently, the chemist is regarded more as a superior sort of workman.

Exponents of a classical education have long deplored the tendency of science teaching to eliminate the Humanities from the curricula of science students, but educationalists are at last beginning to realise that those much abused subjects, Latin and Greek, must occupy a more prominent position even in the training of chemists if clarity of thought and expression are to be achieved.

The exposition of scientific argument, said the speaker, should surely be logical, yet how few of present-day chemists possess the small knowledge necessary to express themselves logically.

Coming to a consideration of defects in the present system, Dr. Brady pointed out that rarely, in the equipment of University teachers, does a knowledge of the science of teaching have place. The result is that the most difficult part of science teaching, the instillation of the principles of Natural Philosophy, is often not well presented.

The deficiency in general knowledge extends not only to Literature and Art, but to Science itself. Few chemists, for instance, have any interest in other branches such as Botany, Biology, Zoology, yet these subjects should be common ground to all scientists. Industry at present calls for men with a knowledge of more than one subject. The modern works-manager is chosen because he is a physical chemist with an acquaintance with engineering, while the best organic chemists are those with biological qualifications. In fact, the complete chemical education must be widened to fit men for these dual capacities.

Speaking of present University difficulties, Dr. Brady mentioned that the curricula have to be adapted to three entirely different requirements. Taught side by side are those whose aim is industrial work, such as administration and analysis, those whose end is the teaching profession, and those destined for purely academic research work.

Obviously, complete co-education of all three types is impossible, and at present the courses are best adapted to the research worker. His requirements are the opportunity for reading, while actual memorisation plays only a small part. On the other hand, the prospective teacher requires a thorough groundwork in the principles of

chemistry, a thing too often lacking in modern training, and with whom practical work is of minor importance. Constant practice in manipulation is the proper preparation for the analysts, in other words, a course consisting chiefly of laboratory work.

From such considerations, the lecturer drew up his scheme for an ideal education. Recognising that the present period of three years is quite inadequate preparation for a degree, he said he would like to see the Universities once again made places where a general education in all branches could be obtained. The prospective chemist, while acquiring this, could find out his natural aptitude, whether for research, the teaching profession, or industrial work. Then, at the end of three or four years, he would proceed along with others of the same mind to a Technical College or University, where the type of training suitable to his chosen career could be obtained.

BRITISH INDUSTRY AND THE CANADIAN MARKET.

MASSED REPRESENTATION OF MANUFACTURERS AT THE TORONTO FAIR.

The Federation of British Industries has decided to inaugurate a British Section at the next Canadian National Exhibition, to be held at Toronto next year.

The question of trade with Canada is of the utmost importance at the present time for more than one reason. The high tariff barrier which has been erected by the recent legislation in the United States is debarring Canadians from selling their products in the United States, with the result that they are also tending to buy less from that country. Great Britain must benefit considerably from this state of affairs. The very favourable harvest which Canada has enjoyed this year has also done a great deal to restore her purchasing power, and there is every reason to anticipate that she will become an increasingly important purchaser of British goods in the near future.

As a result of these facts considerable interest is being manifested in the Canadian National Exhibition, the most important trade gathering of its kind held on the American Continent, and possibly in the world.

Founded in 1879, the Exhibition has been held annually ever since, with a regular in-

crease both in size and in the number of visitors. It now attracts during its fortnight's run an average of about 100,000 visitors per day, and in the years since the war the attendance has increased with surprising regularity at the rate of almost exactly 100,000 per year, until this year it reached the surprising total of over 1,300,000. It is hoped that next year there will be a million and a half visitors.

The Exhibition grounds cover 264 acres, and contain 80 buildings. There is nearly one mile of water front, and, in fact, in the matter of site and organisation the show is unique. It is held for a fortnight at the latter end of August.

Although a few British manufacturers have for many years been in the habit of exhibiting at the Exhibition with marked success, the bulk of the manufactured goods exhibited have been either of Canadian or American origin, and it is felt that the participation of U.K. firms should be very much greater, in view of the opportunities for British business in Canada which exist at the present time.

It is with this aim in view that the F.B.I. has decided to start a British Section. Realising, moreover, that one of the obstacles confronting British firms is the distance from England to Canada, and the expense and trouble necessitated in arranging an individual exhibit, a scheme has been prepared in which the Federation will undertake all the preliminary work and trouble of arranging exhibits.

An adequate block of space in one of the principal buildings is being held at the Federation's option by the Exhibition authorities, and on this block it is proposed to erect a group of stalls to be placed at the disposal of British firms at advantageous terms. An expert staff from the Federation's Head Office will go to Canada some time before the commencement of the Fair, to undertake this work, and will erect the stalls, receive, unpack and arrange exhibitors' samples, and arrange also, where desired, for expert representation of any firm during the run of the Exhibition.

For this a fixed inclusive rate will be charged, and firms will be relieved of the considerable trouble and heavy expense of sending a representative of their own to arrange the exhibit. A further advantage will be the offer of small and inexpensive spaces to firms unwilling to incur the expense of a complete stall. The grouping together of British exhibits will give importance and weight to even a small exhibit

which it would not possess if merely placed haphazard among other and larger displays.

In the centre of the Section will be placed a Federation stall, which will act as a general headquarters and information bureau for visitors interested in British products.

It is necessary, of course, if the "collective" exhibit is arranged that it should be well supported. A section that is too small to have an impressive effect will hardly be worth undertaking, but trade conditions generally, and the prospects of business with Canada, are such that it is hoped a great number of firms will avail themselves of this opportunity of attacking the market.

THE PRESENCE OF LEAD IN BEER.

Some references have been made recently in the public press to an outbreak of illness due to the presence of lead in beer. It appears, from a report submitted by a medical officer of health to his urban authority, that in July last a number of typical cases of lead poisoning were traced to beer retailed by a group of houses in a suburb of London. The houses in question had recently been fitted with cylindrical cast-iron tanks lined with a vitrified enamel. Samples of beer collected from these tanks were found to contain lead varying from a minute trace to over a grain per gallon. An analysis of the enamel showed the presence of some 41 per cent. of oxide of lead, and, moreover, the enamel was of so inferior a quality that it readily disintegrated when in presence of beer. It is a matter of surprise that an enamel of so unsatisfactory a character was used by the manufacturer for lining vessels destined to be used as containers of beer. The brewery who owned the houses at once had every tank removed, and no trace of lead has been found in the beer since.

In cases where casks are not used and beer is delivered in bulk, heavy earthen stoneware tanks, made in one piece and lined with a leadless glaze, have been used for cellar work. In some quarters these are being replaced by the lighter and more convenient iron tank, and those who are installing tanks would be well advised to make it perfectly clear to the manufacturers that only a leadless glaze is to be used.

It is fortunate that the outbreak was so quickly traced to its source, and by prompt action suppressed.

MISSING ELEMENTS IN THE PERIODIC TABLE.

BY F. H. LORING.

If the reader will refer to a paper of mine published in *The Chemical News* (1912, vol. CVI., p. 37) it will be noticed that reasons are deduced for supposing that the rare-earth elements from praseodymium to the end member preceding tantalum, taken inclusively, number 13. Reproducing here-below Table I., which is similar to the one given in my book, "Atomic Theories," page 162 (see also *Chemical News*, 1920, CXXI., p. 315; or *Science Abstracts*, 1921, p. 481, Section A.), it will be seen that 13 identified rare-earth elements form a distinct group, as is well known; but, in order to have 14 elements to fit the places demanded by the atomic-number sequence, one with an atomic number 54+7 is necessitated. This one has not been discovered.

TABLE I.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

[illegible]

At No. of $\Pi - \infty$ ($\Pi = 1$). Ems. = Abbreviation for Emanations.

(Continued from cerium) ↑ Pr. Nd. $\begin{matrix} 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12 & 13 & 14 & 15 & 16 & 17 & 18 \end{matrix}$ Eu. Gd. Tb. Dy. Ho. Er. Tm. Yb. Lu. Cf. These are the rare-earth series.

table is complete in respect of places, however, as the radio atoms not shown would be isotopic with those shown and fit into the places occupied by those elements shown from Tl to U.

No radio-atoms have been discovered which are eligible for these places.

In this Table the usual Group Places are indicated by the Roman numerals. The Arabic figures indicate the electrons in the atom which become the atomic numbers when added as indicated. A represents the electrons in the inner part of the atom which *do not* function in chemical reactions or combinations. B represents the electrons outside of A which *do*, more or less, function in chemical reactions or combinations.

Each symbol stands for a *place* which may contain isodopes, thus:—

I	J
Li	K
At. Wt., 6.94	At. Wt., 39.10
Isotopes 6 and 7	Isotopes 39 and 41
Atomic Number 3 (or 2+1)	Atomic Number 19 (or 18+1)
	&c. . .
	N _a
	At. Wt., 14.008
	No isotopes
	Atomic Number 7 (or 2+5)

isotopes thus:

This Table is based upon a similar one constructed by Langmuir in elucidation of the Lewis-Langmuir theory of electrons, valency relations, etc., which govern the chemical and physical behaviour of the elements either singly or in combination, or even in a state of ionisation. For further Notes respecting this Table, see next page.

NOTES (continued).

It will be seen that the numbers indicated by the letter A are those of the inert gases, representing the electrons in the respective atoms of these elements. This series of numbers, 2, 10, 18, 36, 54 and 86 may be derived from the following equation due to Rydberg:—

At. No.

$$\text{inert gases} = 2(1 + 2^2 + 2^2 + 3^2 + 3^2 + 4^2 + \dots)$$

Stopping off at each squared term gives the above values thus:—

$$2(1) = 2$$

$$2(1+2^2) = 10$$

$$2(1+2^2+2^2) = 18$$

etc.

This table presents certain misleading features because it is shown on one plane. If the reader will imagine the block of elements Li—Na to F—Cl gradually rising upwards from the plane of the paper, so that at the F—Cl side the elevation will be the greatest, he will then be able to differentiate this block in its higher places from those elements below it. The same type of gradual rise also applies to those elements terminated by Br and I, so that the levels for F, Cl, Br and I will be about the same, while manganese would be on the lower level. By this arrangement it will be seen that the two slopes blend fairly evenly at Li—Na, K—Cs. In fact, if the table is cut in two parts and pasted on wedges, a short and a long one, this idea will at once be clearer, and perfect chemical regularity will be obtained when the elements are judged by their *levels* as well as by their positions on the flat plane of the paper. Strictly speaking, the wedges would have a slight transverse slope, and a third wedge would take the remaining elements, so that the table in perspective would resemble in some respects the schemes of G. Martin and of A. W. Stewart.*

* See *Recent Advances in Inorganic and Physical Chemistry*, 4th Edition, by A.W.S.

Referring to Table I., it will be seen that there are so many elements missing from the 7th places, that this peculiarity is of special significance; but there is one element missing in the 1st place (*i.e.*, in Group I.), which is an analogue of caesium. Commenting on this peculiarity, both places represent extremes in chemical activity, except that the one of the rare-earth group might not represent as much activity as the corresponding ones above it. This transition in properties is not unique in the

Table. The position of manganese below chlorine is a striking example; but it must be remembered that in all probability the curve of change, if it may so be expressed, is very steep at this point, as is the case in some other parts of the Table; in fact this transition in properties occurs elsewhere along the same series, *e.g.*, chromium, a metal, is not in some respects like sulphur. This form of table has to be read in a cross-wise direction, so that F, Cl, Br and I are taken together, but this cross reading disappears on approaching the elements of Group I. This is fully explained on the basis of "levels" in the Notes on the Table. On this account, where the rare-earth elements cross Group VII., there would be no element closely resembling the halogens, assuming the existence of this element. For this reason, the chemical activity here referred to has to be interpreted in a way not perhaps fully appreciated as yet, and it may be related to the problem of the missing elements.

If now the atomic numbers of all these missing elements be tabulated, it will be noted that there is a certain regularity in the differences. Table II. shows this regularity, which is expressed mathematically after the manner of the Rydberg equation given in the above Notes; but, to state matters cautiously, the arithmetical treatment here given does not represent a true series, as would be the case if the lowest value were 6 instead of 2 (compare Table III.). However this may be, the regularity on the whole seems sufficiently striking to be of suggestive interest.

TABLE II.		
At. No.	Diff.	Series.
87	---	2(1) = 2
85	--- 2	
-	-10	2(1+2 ²) = 10
75		
-	-14	2(3+2 ²) = 14
61		
-	-18	2(5+2 ²) = 18
43		

It would therefore seem important to distinguish between a process which, when it operates, follows a given law, and the evidence that such a process always produces something. The law may be rigorously true, as in the case of the Mosely-van den Broek sequence; but, and this is the point to be noted, the material which was neces-

sary for the production of the elements may have been at times "insufficient"—in some unknown way, perhaps one involving instability of some kind—to give expression to the law, so that lacunæ may exist which represent very few elements formed, or in rare instances, none at all.

The obvious conclusion from this study is that these missing elements will never be discovered, or if they are discovered their quantities will be extremely minute.

In conclusion, it might be worth while to bear in mind the series given by Table III., for it involves only one discordant gap which further investigation of the radio-elements might remove, though at present this seems unlikely. It is of possible interest to note that the atomic number 93 represents a limit to the series, 92 being the highest atomic number known. Extending the series in a downward direction, as shown, would involve the atomic number of scandium, and this element is known to exist only in very minute quantities relative to those elements on each side of it.

TABLE III.		
At. No.	Diff.	
93	—	2
UX ₂ =91	—	6
85	—	10
75	—	14
61	—	18
43	—	22
Sc=21		

UX₂ also exists in quantities relatively small compared to the radio-elements on each side of it.

SUMMARY.

(1) The absence of certain elements in the 7th places of the Periodic Table; (2) the small quantities of scandium in existence relative to elements on either side of it; (3) the missing of places I. and VII. in radioactive changes; (4) the number of existing rare-earth elements Pr to Ct inclusive being by certain considerations limited to 13, and being in harmony with a blank atomic-number lacuna 54+7; are all accounted for by one or two types of mathematical series based upon atomic-number differences, the series also having a limiting characteristic in agreement with the extent of the atomic

numbers. The deduction therefrom follows that these missing elements do not exist, or if they do exist, they are present in exceedingly minute quantities. As a subsidiary development of this study, the chemical and electronic characteristics of the elements (atoms) can be elucidated by means of a table as designed by Langmuir, but arranged on short and long wedges, so that all elements on a given level will be closely allied, while the displacements along a plane will conform to the electronic states of the atoms. Extending this idea, a third very long wedge would seem necessary, which would include all the remaining elements; but its lower half would be incomplete after uranium, as the limit is fixed by the above-mentioned series.

October 15th, 1922.

MEETINGS OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, NOVEMBER 9, 1922.

Sir Charles Sherrington, President, in the Chair.

The following papers were read, the summaries here printed having been supplied by the authors for use at the meeting:—

PROF. H. E. ARMSTRONG, F.R.S.: *Studies on Enzyme Action. XXIII. Homo- and Heterolytic Enzymes.*

PROF. A. V. HILL, F.R.S., and W. E. L. BROWN: *The Oxygen-Dissociation Curve of Blood and its Thermodynamical Basis.*

An attempt has been made to test the validity of the hypotheses (i) that the reaction of hæmoglobin with oxygen is represented by the equation $(\text{Hb})_n + n\text{O}_2 \rightleftharpoons (\text{HbO}_2)_n$, where Hb represents the simplest possible molecule of hæmoglobin (containing one atom of iron), and n the average degree of polymerization of the molecule in the presence of the salts in blood; and (ii) that the dissociation curves of oxyhæmoglobin under various conditions can be deduced by simple application of the Laws of Mass Action.

The heat of reaction q of one grm. mol. of hæmoglobin (Hb) with oxygen has been determined by the application of the van't Hoff isochore to the effect of temperature on the dissociation curve of blood: while the heat of reaction Q of one grm. mol. of

O₂ with hæmoglobin has been measured directly in a calorimeter. The value of q/Q so found should be equal to n determined in other ways, if the hypothesis be correct, and presumably not otherwise: actually the values are very close to one another, thereby affording strong confirmation of the hypothesis.

The apparent heat of reaction of oxygen with blood may be very considerably reduced by the driving off of CO₂ by the more acid oxyhæmoglobin formed. A direct measurement of the heat of combination of CO₂ with blood has been made, and the value obtained confirms the theory that CO₂ combines with blood by taking base from the ionized hæmoglobin salt to form bicarbonate, leaving the unionized hæmoglobin acid.

The heat of combination of CO with hæmoglobin in blood has been measured, and found to be about 50 per cent. greater than that of oxygen: this proves the existence of an effect of temperature on the equilibrium of O₂ and CO with blood.

H. HARTRIDGE, M.D., and F. J. W. ROUGHTON: *The Velocity with which CO displaces Oxygen from its Combination with Hæmoglobin*. Parts I. and II. Communicated by Prof. F. G. Hopkins, F.R.S.

PART I.

A method has been devised for determining the velocity with which carbon monoxide gas can displace oxygen from combination with the hæmoglobin molecule. Advantage has been taken of the fact that while light falls on a solution containing oxyhæmoglobin and carbon monoxide hæmoglobin, the incoming light energy changes the position of equilibrium, tending to cause a reduction in the amount of COHb with a corresponding increase of the O₂Hb. In the dark the original position of equilibrium is gradually returned to, the rate of return depending on the velocity constants of the reactions. If by a suitable technique the percentage saturation of the hæmoglobin with CO gas could be determined at various intervals of time after the light had been turned off, the velocity constants could be calculated from the determinations thus obtained.

The method used consists essentially in causing the fluid to flow through two glass tubes in series with one another. In the first the solution is exposed to a powerful light, so that the position of equilibrium is altered. In the second tube it is kept in

the dark, so that the original position of equilibrium is gradually returned to as the solution flows down it.

The actual percentage saturation with CO gas of the solution at different parts of the "dark" tube was determined with the reversion spectroscope previously described. At 15° C. the two velocity constants were found to have mean values of 0.0067 and 0.55 respectively.

At 34.5° the value of K₂ was found to be .266, which gives a temperature coefficient for this velocity constant of 2.3 for a 10° C. rise of temperature. This temperature coefficient is approximately that given by many ordinary chemical reactions. With change in H ion concentration by addition of CO₂, K₂ had a value of 0.71, but the difference between this value and 0.55, previously obtained without CO₂, may have been due to experimental error, *e.g.*, to chance fluctuation in the intensity of the catalyzing light source.

PART II.

1. The method of measuring the velocity of the reaction $\text{CO} + \text{O}_2\text{Hb} \rightleftharpoons \text{COHb} + \text{O}_2$ consists in ascertaining, by means of an electrically controlled stop-watch, the time taken for the equilibrium to shift from an unstable position to a stable one, the change in equilibrium being ascertained by measurements on the absorption bands by means of the reversion spectroscope.

2. The system was changed to an unstable position by (1) subjecting the solution under investigation to the action of a powerful beam of light, which caused a new position of equilibrium to be taken up, and by (2) suddenly obstructing the light rays, thus causing the system to become unstable with a rapid return to the original position.

3. This method avoided the two errors to which that of the previous paper was liable, *viz.*, chance fluctuations in the catalyzing light source, and irregularity in the flow of the liquid under observation, but it involved instead the difficulty of making accurate estimations on absorption bands moving from one position in the spectrum to another.

4. Observations of K₂, the equilibrium constant, were made by method (1) at 1° C. and laboratory temperature, and by method (2) at laboratory temperature and 34° C.; the two sets of values by the two methods at laboratory temperature can, therefore, be compared. Method (1) gave

0.51 and 0.59, and method (2) 0.44 and 0.40.

5. Temperature coefficients per 10° C. were calculated from values given by the two methods; it was found that 2.3 was the value given by method (1), and 2.5 and 2.7 those given by method (2). The agreement is very close, the mean value being 2.5.

L. T. HOGGEN: *Studies on Internal Secretion. I. The Effect of Pituitary (Anterior Lobe) Injection upon Normal and Thyroid-ectomized Axolotls.* Communicated by Prof. E. W. MacBride, F.R.S.

1. While pituitary feeding was found to have no influence on the metamorphosis of medium-sized or sexually mature Axolotl larvæ of *Amblystoma tigrinum*, injection of anterior lobe extracts into Axolotls of the same ages and dimensions was followed by the assumption of the adult characteristics, with rapidity comparable to metamorphosis induced by thyroid administration, and beginning about two to three weeks after the initial injection.

2. The operation of the thyroidectomy in medium-sized or mature Axolotls is described, and the efficacy of anterior lobe extracts to induce metamorphosis in thyroidless larvæ is indicated.

3. Transplantation of the thyroids of a large sexually mature Axolotl into a medium-sized individual was accomplished successfully without any production of metamorphic changes.

4. Spontaneous metamorphosis does not generally occur, as Marie de Chauvin stated, in larvæ of six to nine months when placed in shallow water with opportunities for emerging.

L. T. HOGGEN and F. R. WINTON: *The Pigmentary Effector System.—II.* Communicated by Prof. E. W. MacBride, F.R.S.

1. The existence of a nervous mechanism of pigment control is explored in the light of experiments on the section and stimulation of nerves and the administration of drugs.

2. Apart from caffeine, the only reagents found to induce melanophore contraction were those known to excite peripheral sympathetic nerve-endings, namely, adrenalin, tyramine, ergotoxine and cocaine.

3. Apart from pituitary extract, the only reagents found to bring about melano-

phore expansion were apocodeine and nicotine, in quantities sufficient to paralyse all sympathetic nerve-endings.

4. No unequivocal direct evidence has, however, been advanced, either in this investigation or by previous workers, to demonstrate a nervous control of pigment responses in Amphibia.

5. The possibility is indicated that the synchronous colour changes of Amphibia in response to normal environmental stimuli are determined mainly by endocrine influences.

A. FLEMING and V. D. ALLISON: *Further Observations on a Bacteriolytic Element found in Tissues and Secretions.* Communicated by Sir Almroth Wright, F.R.S.

Strains of *M. lysodeikticus* resistant to lysozyme action can readily be developed.

The resistance is not specific, *i.e.*, strains made resistant to one tissue or secretion are equally resistant to all tissues, whether derived from man, the lower animals, or from vegetables, showing that the lysozyme affecting *M. lysodeikticus* is the same whatever is the tissue it is derived from.

After solution of a large number of *M. lysodeikticus* there is an increase in the lytic power of the fluid, and this increase affects wholly or mainly the homologous microbe.

Different tissues and secretions vary in their capacity to dissolve different bacteria, and some tissue extracts have a marked lytic action on many of the well-known pathogenic bacteria.

THE ROYAL SOCIETY.

THURSDAY, NOVEMBER 9, 1922, AT 4.30 P.M.

Papers read:—

PROF. H. E. ARMSTRONG, F.R.S.: *Studies on Enzyme Action. XXIII.—Homo- and Hetero-lytic Enzymes.*

PROF. A. V. HILL, F.R.S., and W. E. L. BROWN: *The Oxygen-dissociation Curve of Blood and its Thermodynamical Basis.*

H. HARTRIDGE, M.D., and F. J. W. ROUGHTON: *The Velocity with which CO replaces Oxygen from its Combination with Haemoglobin.*—Parts I. and II. Communicated by Prof. F. G. Hopkins, F.R.S.

L. T. HOGGEN: *Studies on Internal Secretion. I. The Effect of Pituitary (Anterior Lobe) Injection upon Normal and Thyroid-ectomized Axolotls.* Communicated by Prof. E. W. MacBride, F.R.S.

L. T. HOGGEN and F. R. WINTON: *The Pigmentary Effector System*. II. Communicated by Prof. E. W. MacBride, F.R.S.

A. FLEMING and V. D. ALLISON: *Further Observations on a Bacteriolytic Element found in Tissues and Secretions*. Communicated by Sir Almroth Wright, F.R.S.

It is usually possible for a Fellow to obtain an abstract of a paper in which he is interested, by application to the Assistant Secretary a day or two in advance.

ORDINARY MEETING—NOVEMBER 2, 1922.
Sir Charles Sherrington, President, in the Chair.

The following papers were read, the summaries here printed having been supplied by the Authors for use at the meeting:—

LORD RAYLEIGH, F.R.S.: *Polarisation of the Light scattered by Mercury Vapour near the Resonance Periodicity*.

The chief results of the present investigation are:—

(1) White light scattered at right angles by dense mercury vapour is to a first approximation completely polarised.

(2) Ultra-violet radiation of the mercury spectrum line λ 2536, when examined immediately it enters mercury vapour in an exhausted vessel at room temperature, gives a scattered radiation which is slightly though definitely polarised.

(3) This polarisation has been observed to increase as the beam is filtered by penetration of a considerable depth of vapour. After penetration of 27.5 cm. of vapour the weaker polarised image had 60 per cent. only of the intensity of the stronger one, instead of 90 per cent. as at first. The radiation removed by the filtration appears to lie within a spectral range of about 1/100 angstrom.

G. P. THOMSON: *The Scattering of Hydrogen Positive Rays and the Existence of a Powerful Field of Force in the Hydrogen Molecule*. Communicated by Sir J. J. Thomson, F.R.S.

(1) At a pressure of less than 1/100 mm. hydrogen positive rays of 10,000 volts mean energy suffer considerable small-angle scattering in a distance of 15 cm.

(2) This scattering is very much (10-20 times) greater than would be expected on theoretical grounds.

(3) There must, therefore, be a field of force in the hydrogen molecule at distances of the order of 10^{-8} from a nucleus which

is much stronger than would be expected from the inverse square law.

(4) A subsidiary experiment throws great doubt on Glinne and Koenigsberger's "Stosstrahlen."

H. D. SMYTH: *A new Method for studying Ionizing Potentials*. Communicated by Sir E. Rutherford, F.R.S.

A new mode of attack on ionizing potential problems is suggested. The principle involved is the use of positive ray analysis to study the ions produced in a gas or vapour by the impact of slow-speed electrons of known energy. This requires that the density of gas be considerable where the energy of the impacting electrons is known, and as small as possible where the energy conditions are not known.

In the case of mercury such a localisation of vapour density was obtained by using a unidirectional molecular stream similar to that employed in a mercury diffusion pump. Ions were produced by electrons from a hot filament, and after acceleration by a large electric field were analysed by a magnetic field. In this way the values of m/e were determined approximately.

The results of the experiments on mercury indicate the formation of doubly charged ions at 19 ± 2 volts. The series relations of the enhanced spectrum of mercury are not known, but analogy with zinc and cadmium suggests an estimate in agreement with the above value. The conclusion is that the double ions formed at this voltage are the result of two impacts. Experiments at higher voltages, however, indicate formation by single impacts.

More highly charged ions were present in such small quantities as to make their identification uncertain even at voltages as high as five hundred. It was also impossible to identify a singly charged diatomic molecule.

I. BACKHURST: *Variation of the Intensity of Reflected X-radiation with the Temperature of the Crystal*. Communicated by Sir W. Bragg, F.R.S.

Sir W. H. Bragg's early work has been extended to a variety of crystals and higher temperatures. General agreement only is found with the theories of C. G. Darwin and P. Debye.

Aluminium.—A very marked decrease in intensity was observed with rise of temperature, and fair agreement with P. Debye's theory obtained for the (100) and (222) spectra.

Carborundum.—A special furnace was constructed for temperatures up to 960° C. and no deterioration of the crystal was observed. The decrease in intensity with rise of temperature was much greater for the higher-order spectra, and different curves were obtained for the K α (333) and K β (333) spectra.

Graphite.—Only for the cleavage-plane reflection was it possible to obtain a definite temperature-intensity curve, and for the direction perpendicular to this plane an unusually high coefficient of expansion was measured.

Diamond.—No decrease in intensity was found that could be measured with certainty, and a very small thermal agitation would be expected on account of the diamond structure's great strength.

Ruby and Sapphire.—An anomalous effect was observed, since the decrease of intensity of the (111) spectra was greater than that of the (222). This may be completely explained by assuming that the atoms of the aluminium pair remain in contact and do not share in the expansion of the lattice.

S. DATTA: *The Absorption Spectrum of Potassium Vapour*. Communicated by Prof. A. Fowler, F.R.S.

(1) The principal series lines up to $m=42$ have been observed as absorption lines and their wave-lengths accurately measured. The series equation shows satisfactory agreement between the observed and the calculated values, with the exception of deviations for the last few lines, for which a possible explanation has been given.

(2) The first seven members of the series have been resolved into their components as compared with five in previous investigations.

(3) Besides the absorption of the lines of the principal series, new lines have been found to be absorbed at higher pressures, which seem to have no correspondence with the known lines in the emission spectrum.

(4) The combination lines $1s-2d$ and $1s-3d$ have been found to be absorbed, the first as a pair, confirming the presence of a satellite to the lines of the diffuse series. Their appearance in the absorption spectrum gives distinct evidence of contradiction of the selection principle.

K. R. RAMANATHAN: *The Molecular Scattering of Light in Vapours and in Liquids and its Relation to the Opalescence ob-*

served in the Critical State. Communicated by Dr. G. T. Walker, F.R.S.

(1) Three instances of light scattering by homogeneous media are known—opalescence near critical point, scattering of light by gases, and scattering of light by liquids. The investigation was undertaken to test the view of Prof. C. V. Raman that these phenomena are fundamentally related, and that intensity of scattering in all these cases should be represented by the Einstein-Smoluchowski formula, which is more general than the Rayleigh law of scattering and supersedes it, except in the special case of gases obeying Boyle's law.

(2) Experiments on scattering of light by ether, in vapour and liquid phases, at different temperatures from 33° C. up to critical temperature 193.6° and in gaseous phase from 193.6° to 217°, are described.

(3) The results are in accord with the E.S. formula and not with the Rayleigh law.

(4) The E.-S. formula is inapplicable in immediate neighbourhood of critical point. The scattered light is markedly less blue here. Following the theoretical work of Ornstein and Zernike, from maximum value of intensity of scattered light the value of ϵ , radius of action of ether molecule, is deduced to be 4.6×10^{-7} cm.

(5) Light scattered at right angles to incident beam is imperfectly polarised; ratio of weak component to strong is throughout nearly 1.2 per cent., in case of vapour, while in case of liquids, ratio is 8 per cent. at ordinary temperatures, remaining constant till about 120° and then falling off to about 1.2 per cent. at critical point. There is no change of imperfection of polarisation on passing through critical point. Correction due to this in expression for intensity of scattered light is given.

LIST OF PROBABLE PAPERS FOR READING, NOVEMBER 23, 1922.

DR. T. E. STANTON, F.R.S.: *On the Characteristics of Cylindrical Journal Lubrication at High Values of the Eccentricity*.

PROF. F. C. THOMPSON and E. WHITEHEAD: *On the Changes in Iron and Steel at Temperatures below 280° C.* Communicated by Prof. H. C. H. Carpenter, F.R.S.

J. H. JEANS, SEC. R.S.: *The Propagation of Earthquake Waves*.

PROF. F. A. LINDEMANN, F.R.S., and G. M. B. DOBSON: *A Theory of Meteors and*

the Density and Temperature of the Outer Atmosphere to which it leads.

C. F. JENKIN: *The Fatigue Failure of Metals.* Communicated by Sir Alfred Ewing, F.R.S.

S. BRODETSKY: *The Line of Action of the Resultant Pressure in Discontinuous Fluid Motion.* Communicated by Sir George Greenhill, F.R.S.

DR. R. A. HOUSTON: *An Investigation of the Colour Vision of 527 Students by the Rayleigh Test.* Communicated by Prof. A. Gray, F.R.S.

ROYAL INSTITUTION.

A General Meeting of the members of the Royal Institution was held on the 6th inst. Sir James Crichton-Browne (Treasurer), in the chair. Viscount Falmouth, Dr. Michael Grabham, and Mr. N. Miesegaes were elected members. The Chairman reported the deaths of Colonel E. H. Grove-Hills, Secretary and Vice-President, and of Lord Scott Dickson, and resolutions of condolence were passed.

THE MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

JOULE MEMORIAL LECTURE.

The Hon. Sir Charles A. Parsons, K.C.B., M.A., D.Sc., F.R.S., has consented to deliver the Second Joule Memorial Lecture at the Manchester Literary and Philosophical Society's house, on Tuesday, December 5th, 1922, at 4 p.m. The title of the lecture will be, "The rise of motive power and the work of Joule."

The dinner, in honour of the lecturer, will be held the same evening at 7.30.

MINERALOGICAL SOCIETY.

ANNIVERSARY MEETING, NOVEMBER 7, 1922.

Dr. A. Hutchinson, F.R.S., President, in the Chair.

W. A. RICHARDSON: *The frequency-distribution of igneous rocks in relation to Petrogenic theories.*

The distribution of igneous rocks shows a separation into two primary types, probably corresponding to two primary earth shells, which have originated under early planetary conditions. All other rocks are normally distributed about the two primaries, and the probable cause of such a distribution is fractional crystallisation. The frequency distribution lively to result from different petrogenic processes is examined and discussed.

MISS I. E. KNAGGS: *The connection between crystal structure and chemical constitution of carbon compounds.*

It was shown that in certain simple substitution products of methane the crystal symmetry may be predicted from the known configuration of the chemical molecule. The symmetry of a molecule of the type CX_4 is that of a regular tetrahedron, X being either a univalent atom or a group of atoms, which does not destroy the trigonal symmetry about the bonds from the central carbon atom. Compounds of this type crystallise in the cubic system. Compounds in which X is a more complex group, but sufficiently symmetrical to maintain tetragonal symmetry crystallise in the tetragonal system, most frequently in the holohedral class, in which case the crystal is considered to be built up of cells each containing eight molecules. Molecules of the type CX_3Y have one axis of trigonal symmetry, and this symmetry is preserved in the crystal, except when X is hydrogen. The orthorhombic symmetry of molecules of the type CX_2Y_2 is maintained in the crystal.

MISS C. F. ELAM: *Exhibition of coloured lantern-slides illustrating dimorphous changes in fused salts (silver nitrate, potassium nitrate, etc.).*

DR. G. T. PRIOR: *The meteoric iron of Karee Kloof, Cape Province, and the meteoric stone of Leeuwfontein, Pretoria, South Africa.*

The meteoric iron of which a mass of 92 kg. was found at Karee Kloof is a coarse octahedrite having a percentage of nickel of 8.27; the Leeuwfontein meteoric stone of 460 grams which was seen to fall on June 21, 1912, is an intermediate chondrite.

THE INSTITUTION OF MINING ENGINEERS.

ANNUAL GENERAL MEETING, NOVEMBER 16TH AND 17TH, 1922.

As previously announced, the thirty-third annual general meeting of the Institution of Mining Engineers was held, by kind permission, at the rooms of the Geological Society, Burlington House, Piccadilly, W.1, on Thursday and Friday, November 16th and 17th, 1922.

ROYAL SOCIETY OF ARTS.

JOHN STREET, ADDELPHI.
169th Session, 1922-1923.

Arrangements for meetings during November, 1922:—

Monday, November 27th, 8 p.m. (Cantor Lecture): WILLIAM ARTHUR BONE, D.Sc., Ph.D., F.R.S., Professor of Chemical Technology, Imperial College of Science and Technology, "*Brown Coal and Lignites*." (Lecture I.)

Wednesday, November 29th, 8 p.m. (Ordinary Meeting): MAJOR W. S. TUCKER, R.E., D.Sc., "*The Hot-Wire Microphone and its Applications to the Problems of Sound*." Admiral of the Fleet Sir Henry B. Jackson, G.C.B., K.C.V.O., D.Sc., F.R.S., will preside.

OCTOBER EXAMINATIONS OF THE INSTITUTE OF CHEMISTRY.

The following candidates passed the examination for the Associateship in general chemistry:—

Chignell, Guy, B.Sc. (Lond.), University College, Southampton.

French, Herbert, Heriot-Watt College, Edinburgh.

Wild, Francis Eric, B.Sc. (Birm.), Birmingham University.

Young, Edward Bernard, B.Sc. (Lond.), East London College.

The following candidates passed in Branch (d) Organic Chemistry (under regulations in force prior to March, 1920):—

Baguely, Noel Gregory, University College, Nottingham.

Cole, Frederic, University College, Nottingham.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Section I.—Physiology.

THE EFFICIENCY OF MAN AND THE FACTORS WHICH INFLUENCE IT

ADDRESS BY PROF. E. P. CATHCART, M.D., D.Sc., F.R.S., PRESIDENT OF THE SECTION.

(Continued from Page 294.)

This rhythm of work is simply a general example of the formation of a conditioned reflex. The rhythm adopted, although it may suit the worker, is not of necessity the series of muscle movements which lead to the least expenditure of energy. Most probably the rhythm selected is only in small part due to the worker's physical configuration; in greater part it is evolved in imitation of some more experienced or older worker. The average workman is not so much concerned with the diminution of

the physiological cost in the performance of a given act as in the reduction of conscious effort. As Vernon states, "Experienced industrial workers unconsciously adopt habits of work which tend to the production of a maximum output with the minimum of effort."

This capacity of the organism to build up a series of conditioned reflexes is one of the potent factors in the prevention of fatigue. The organism is able not only to build up reflexes in response to the tactile impressions of the material which he handles, of the tools, their shape, weight, &c., with which he works, but even to the extent and duration of the movements which he develops in the performance of his work. The proper and effective linking up of a series of these stimuli lead to a technical rhythm which will not necessarily be identical in the case of each worker in the same shop performing the same operation, but which, viewed generally, will give a colourable representation of uniformity.

It is not, of course, suggested that the methods adopted by workers independently are the perfect methods, and that proper investigation will not discover better and easier methods of performing certain given operations. If newer and more economical methods are to be developed and brought into operation, the only real chance will be to segregate the newer young workers. Vernon gives an excellent example of the necessity of doing so. The output of a certain necessary stock article had to be increased. A factory concerned in the production turned out 5,000 per week, and this could not be increased—the regular workmen had a certain rate and habit of work. A new factory was started, staffed with hands new to the work, and after six months' practice they produced 13,000 articles per week.

There is good evidence, that of Muscio for example, that both resting and working, in addition to the individual muscle rhythm, there is a definite variation in the course of the day in the capacity to carry out work; that, in other words, a diurnal rhythm exists. There is a certain amount of evidence also in favour of the view that a seasonal rhythm exists. As Wilson has put it, "It is tempting to suppose that human performance may be dependent on a number of superimposed rhythms corresponding with the periods of work, beginning perhaps with the rhythm of the actual movement and ending with a seasonal rhythm."

Further, when efficiency is measured in terms of output it is found that there is a definite rhythm in output during the course of the working day and of the working week. It is well known that it takes an appreciable time each day to work up to full power, and this is shown distinctly in the daily output curve, which rises and then drops sharply at the end of the work period. This type of curve is not peculiar to any one industry. The rise is almost certainly due to the "limbering up," and it is probable that the fall towards the end is largely due to voluntary slowing. The total weekly output curve with the low Monday effect and the sharp fall on Saturday resembles in general shape the daily output curve. The main point about these curves is that they seem to demonstrate the absence of progressive fatigue from overwork, which would have been deduced had there been a sharp rise at the commencement of the week, followed by a steady fall.

The third of the potent factors in the control of fatigue is rest. If work is done rest is ultimately imperative. Rest not merely relaxes the muscle, allowing a more thorough and complete removal of the waste products and a more abundant supply of oxygen, but it removes the strain of attention. Rest is best obtained not by simple quiescence but by change of posture; slow movement of another type to that which produced the fatigue will, unless the organism is tired practically to complete exhaustion, give the most beneficial results. It is common knowledge that when the attention is concentrated, when our interest, either in the work or in something cognate or even foreign to it, is thoroughly aroused spells of work or intensity of effort in its performance may be borne, which under other circumstances might tax our resources to the last degree.

Forced work, *i.e.*, work carried out at a pace other than that of the performer's own selection, is much more exhausting and destructive than where the subject is permitted to work at a rate of his own selection. Laulanié, assuming that fatigue had a purely physical origin, went the length of maintaining that muscles spontaneously find the optimum rate of work where the intervals of repose exactly suffice for sufficient recuperation, so that long spells of work may be done. Such a conclusion does gain a certain amount of support from the consideration, for example, of the cardiac cycle.

So far, little attention has been paid to the duration of the rest period in relation to the work done. As a general rule, it may be said that, in the majority of occupations, although the hours of labour are continuous, the actual spells of hard manual work are discontinuous, either due to the fact that certain operations are intermittent in their severity, that supplies of material are not constant, or that, if these more or less natural conditions do not operate, rests at irregular intervals are deliberately taken by the operative.

So far as I am aware there is only one type of hard work where a definite rest period is laid down as part of the exercise, namely, in Army route marching. Marching as a costly form of energy expenditure is unique in that it is a continuous repetitive act carried on frequently for hours on end. The Regulations lay down that a definite rest period shall be taken every hour. Marching, too, is peculiar in another way, namely, that the rate of marching is fixed, *i.e.*, a certain definite rate has to be constantly maintained throughout the marching period.

(To be continued.)

NOTICES OF BOOKS.

Grundzüge der Angewandten Elektrochemie, von Dr. GEORG GRUBE. Band I., *Elektrochemie der Lösungen*. Pp. XII, + 268. Dresden and Leipzig: Verlag von Theodor Steinkopff. 1922. Price unbound 8s. 4d., bound 10s. 3d.

The adverse rate of exchange makes it increasingly difficult for German scientists to procure English and American publications, and thus Dr. Grube is probably unacquainted with many recent advances in the subject of his book, conducted by workers in this country and America. Otherwise, he has given a good account of the electrochemistry of electrolytic solutions, and has included the results of researches published within the last year.

The early chapters deal in detail with the Laws of Electrochemistry.

Electro-metallurgical processes, including the refining of metals, and electrochemical methods of analysis, are then described. Next follows a full account of the electrolysis of alkali chloride solutions, together with the manufacture of hypochlorites and chlorates. There is a short but good chapter on Electrolytic Oxidation,

in which the preparation of per-salts is touched upon.

The applications of electro-chemical reduction and the technical electrolysis of water conclude this volume.

The author has dedicated his book to Prof. F. Foerster, along the lines of whose *Elektro-Chemie wässriger Lösungen*, it follows.

The book is suitable as a textbook for students of Physical Chemistry, and also as a source of information for more experienced scientists.

The Czecho-Slovak Republic, by J. CISAR and F. POKORNY. Pp. 218. London: T. Fisher Unwin, Adelphi Terrace, W.C. Prague: Orbis Publishing Co. 1922. Price 9s.

Of the new countries that have arisen as a result of the war, not one can show such a record of progress as has been made by Czecho-Slovakia.

Whilst most European currencies are depreciating—in some cases almost to the point of collapse—the Czech crown has steadily increased in value to the present rate of 140 kronen to the pound sterling.

The authors of the present volume on their country give a complete survey of the land and its people (Part I.).

Of special interest to scientific readers are the chapters on Education, Science and Philosophy. Few of the English public are aware of the high level attained by the Czechs in these and other spheres.

The Charles University of Prague was founded in 1348, and is associated with the names of Kepler, Tycho Brahe, Kommenius, and many other distinguished pioneers. In recent times the university has produced many distinguished men of science, whose work will be familiar to their confrères in other lands.

Part II. gives a comprehensive economic survey of the new State. The mineral wealth is said to be extensive, and certainly the output of metal products is considerable.

Bohemian glassware has long been known in England, and the same applies, but to a lesser extent, in the case of porcelain and pottery.

The chemical industries have also been well developed along scientific lines.

The English general and scientific public would gain much sound, if striking, information concerning the Czecho-Slovak Republic by a perusal of this most interesting

book, the value of which is further enhanced by numerous fine illustrations.

J.G.F.D.

BOOK RECEIVED.

The Theory of Allotropy, by A. SMITS, PH.D., Translated from the German with the Author's sanction, by J. Smeath Thomas, D.Sc. Pp. XIII. + 397. 1922. Messrs. Longmans, Green & Co., 39, Paternoster Row, E.C.4. 21s. net.



This list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 28995 Aische, M. I. Production of organic sulphonated oils of animal origin. Oct. 25.
- 29239—Techno-Chemical Laboratories, Ltd.—Rotatable heat-transmitting appliances. Oct. 26.
- 29532—West, J. H.—Manufacture of ammonium compounds. Oct. 28.
- 29371 Napp, H. R. Process of manufacture of 1-phenyl-2,3-Dimethyl-4 dimethyl-amino-5-pyrazolone. Oct. 27.

Specifications Published this Week.

- 87046 Schrieber, T. Process for the production of sulphuric acid.
- 187035 Holmes & Co., Ltd., W.C. Manufacture of sulphate of ammonia.
- 186051 Wade, H. Manufacture of alcohol ether mixtures.
- 18690 British Thomson-Houston Co.—Chemical apparatus for precipitation purposes.
- 186129 Incey, O. V. Manufacture of optically-active aromatic amino-alcohols.
- 173529 Clerc, C. Manufacture of magnesia from dolomite.

Abstract Published this Week.

Explosives. Patent No. 18555. A new preparation for explosives has been Patented in this country by Mr. H. Rathsburg, of 25, Moststrasse, Furth, Bavaria, Germany.

Explosive salts of tetrazol or triazol or their derivatives are used in detonators, percussion caps, &c. These salts may be mixed or precipitated simultaneously to form double or mixed crystals with other ingredients such as azoimide, mono- and polynitrated phenols and their substitution products, such as di- and trinitroresorcin and trinitrophloroglucinol; also metadinitroorthodinitrosobenzene and trinitrodinitroso-naphthol. The salts may also be granulated with paraffin or resins dissolved in benzene, xylene, or carbon tetrachloride. Blasting detonators may contain a top charge of such compositions, for example, a charge of lead azotetrazol over lead or cadmium tetrazylhydride over tetranitroethylamine. The preparation of the following substances is described, namely:—(1) Tetrazol, synthetically from dilute hydrazoic acid and prussic acid, or by reduction of diazotetrazol salts by chloride of tin or alcohol, or by oxidation naphthyltetrazol or aminophenyltetrazol with potassium permanganate; (2) tetrazylazoinide, by splitting tetrazenes or treating tetrazylhydrazine with sodium nitrite and hydrochloric acid; (3) azotetrazol, by oxidizing amidotetrazol in alcoholic solutions with permanganates or persulphates, the amidotetrazol being obtained synthetically from cyanamide and hydrazoic acid or by reconstruction in the presence of sodium acetate of guanylazide salts formed when amidoguanidine salts are diazotized; (4) oxyazotetrazol, by treating diazotetrazol salts with carbonic acid; (5) diazaminotetrazol, by diazotizing amidoguanidine salts with sodium nitride in acetic acid solution; (6) diazotetrazol, by diazotizing amidotetrazol; (7) bistetrazol, synthetically from cyanogen gas and hydrocyanic acid solution; (8) phenyltetrazolcarboxylic acid, by boiling phenyltetrazolcyanide with alcoholic potash lye; (9) methylmercaptotetrazol, by diazotizing methylthiosemicarbazide; (10) phenylethyldioxytetrazol, by decomposing with alcoholic potash lye the phenylacetamide salt thereof obtained during the diazotizing of phenyl salt obtained in diazotizing β -naphthenylamidotetrazol, by decomposing the β -naphthenylamide acetamidobenzenate; (11) 3-naphthenyldioxytetrazol; (12) phenylglycolenyldioxytetrazol, by decomposition of phenylglycolenylamide salts obtained by diazotizing phenylglycolenylamine; (13) benzenyldioxytetrazol, by diazotizing acid benzenylamine and decomposing the benzenylamine salt thus obtained; (14) *m*-nitrobenzenyldioxytetrazol, by diazotizing *m*-nitrobenzenylamine; and (15) *p*-tolenyldioxytetrazol, by diazotizing *p*-tolenylamine and decomposing the resulting *p*-tolenylamine salt with alcoholic potash lye.

Messrs. Rayner & Co. will obtain printed copies of the published Specifications, and forward on post free for the official price of 1s. each.

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ROYAL SOCIETY

GOVERNMENT GRANT FOR SCIENTIFIC INVESTIGATIONS.

A PPLICATIONS for the year 1923 must be received at the Offices of the Royal Society not later than January 1st next, and must be made on printed forms to be obtained from the Clerk to the Government Grant Committee, Royal Society, Burlington House, London, W.1.

PATENTS.

BRITISH PATENT No. 121,294.

IMPROVEMENTS IN EXPLOSIVES.

THE PROPRIETOR of this Patent wishes to give license or to come into relation with someone competent for the industrial working of this Patent.—For particulars write to Mr. A. Van Damme, rue du Montenegro 7, Brussels.

THE OWNERS of British Patent No. 149,374, entitled: "Improved Method of Manufacturing Starch and Conversion Products thereof, and the Improved Product Obtained therefrom," desire to Dispose of the Patent or to enter into working arrangements with a likely interested Firm.

Particulars may be obtained from **HERTFORD RECORD COMPANY, LIMITED**, of Lindsey House, 59, Lincoln's Inn Fields, London, W.C.2.

MISCELLANEOUS.

WANTED.

NATURE, No. 2536 (June 6, 1918), No. 2580 (April 10, 1919), No. 2594 (July 17, 1919).

Engineer, April 5 and June 17, 1918.—Reply, stating price, to "A.S.," c/o *Chemical News*, 97, Shoe Lane, E.C.4.

FOR SALE.

JOURNALS of the **CHEMICAL SOCIETY** for 1915, and 1921, complete with index (unbound), 25s. per year.

Journal of Industrial and Engineering Chemistry 1919, £1. Apply H. E., c/o *Chemical News*, 97, Shoe Lane, E.C.4.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3268

SHALL THE STATE THROW AWAY THE KEYS?

AN EXPOSITION OF WHAT FINE CHEMICALS
MEAN TO THE NATION.

A pamphlet with the above title has recently been issued by the Association of British Chemical Manufacturers, 166, Piccadilly, W., from whom copies can be obtained.

The pamphlet sets out the importance to the nation of the production of Fine Chemicals and the danger of reverting to the pre-war conditions of dependence upon other countries for these necessities.

The Foreword, by Sir W. J. Pope, is of such pressing interest that we have pleasure in publishing it in full:—

A FOREWORD

By Sir Wm. J. Pope, K.B.E., F.R.S., Professor of Chemistry in the University of Cambridge, and President of the International Union for Pure and Applied Chemistry.

The history of a nation in general falls naturally into well defined periods, each limited by some event of large national importance; the last few years have seen the close of one of the great periods in the history of many Empires. We are ourselves now in the opening years of another chapter in the history of our country, and the responsibility rests upon us of weighing up the advantages and disadvantages of the national situation and resources, and of applying the experience gained in the past to the continued development of our great national heritage.

Everyone will agree that the factors affecting our national prosperity are very different from those which ruled before the cataclysm of 1914. Until that date we had been content to amass wealth by the development of many industries in which we were pre-eminent, and to leave others, erroneously presumed to be comparatively unimportant, unlucrative, and unsuited to the British temperament, to be exploited by Germany. Thus, whilst our textile industries were the foremost in the world, we depended almost entirely on the German factories for the dyes essential to

those industries. Many gloomy prophets foretold disaster from permitting the German to control many of our staple industries by allowing him a monopoly for the supply of many essential materials; these Jeremiahs vastly understated the gravity of the situation. Probably few can even yet fully realise the perils which faced us in 1915 and 1916 owing to the fact that the production of many chemical products was entirely in German hands; scarcely any British manufacturing industry can be named which was not in danger of complete stoppage owing to this fact. The production of explosives was hampered because we had but little plant for making fuming sulphuric acid, and our steel industries were endangered because Germany had a monopoly in the supply of the rare metals which are essential components of hard steels.

One of the most surprising events of the war was the facility with which, although at great cost, Great Britain organised sources of supply and improvised methods of manufacture to such effect that at the Armistice we were producing all those essentials for which we had been previously dependent on Central Europe; our success in this direction gives the lie to the statement, made so often by the German, that his countrymen believe it implicitly, that the Briton is temperamentally unfitted to become a chemical manufacturer. The question whether this country will or will not build up a sufficiently organised and completely interlocked fine chemical industry is a perpetual subject for discussion in the German technical journals; the large and illuminating literature on this matter shows that the German realises well that if we succeed our future amongst the nations is assured, but that if we fail, as he hopes, we shall have lost the peace. We shall once more have to rely upon the German factories for the supply of vital materials for our industries. Should another great European war break out we shall not be accorded leisure for improvisation; of perhaps more moment is the fact that, in the increased strenuousness of coming industrial competition, the control of key industries by Germany will provide that nation with an efficient strangle-hold upon our great staple industries. Many instances are given in the following pages in illustration of the fact that a flourishing fine chemical industry is essential to the continued success and development of all our

great manufacturing activities; hundreds more might have been given without exhausting the list. We shall never revert to a condition of healthy commercial rivalry, untainted by the hates and hopes born of the recent war, until we can convince our late enemies that it is the firm determination of Great Britain to place the manufacture of fine chemicals upon an unassailable basis; an instance may be quoted which will make this clear. One of the German fine chemical works has recently produced a material which is said to be a cure for sleeping sickness and other allied tropical diseases; this substance is now being tested under German auspices in British and Belgian Africa. Meanwhile, it was stated at the recent meeting of the German Association of Tropical Diseases that this material is the key to tropical Africa and consequently to all the Colonies, and that the German Government "must be required to safeguard this discovery for Germany; its value is such that any privilege of a share in it granted to other nations must be made conditional upon the restoration to Germany of her colonial empire." A well-organised fine chemical industry in this country could undertake a scheme of work routine-like in its simplicity, which would almost infallibly result in the discovery of a cure for sleeping sickness; if Germany is to be allowed a monopoly in curing a disease which does not occur in her own territory she will thereby forge for herself a very powerful political weapon.

The instance just quoted is interesting as illustrating one peculiarity of the fine chemical industry; it is an industry which deals in specialities, each perhaps small as measured by money values, but each of essential importance to the modern world. Unlike others, the fine chemical industry comprises a vast variety of products, many the outcome of lengthy series of manufacturing operations; it thus lends itself to a very simple method of exploitation which has been largely employed to our disadvantage during the past few years. Just after the Sankey judgment permitted the free entrance of fine chemicals into this country some years since, I had need of supplies of a number of fine chemicals and asked for quotations from Germany. I found that quite small quantities of the substances on my list which were made in this country as well as in Germany would be supplied at dumping prices; those not made in England were quoted at ridiculous prices. Iso-

quinoline, of which I needed some kilos, was quoted at £50 per kilogram; in my necessity I made this substance at a cost of, roughly, £1 per kilogram, but if I had had urgent need of 1,000 kilograms at short notice, I should have been forced to purchase at £50 per kilogram and should thus have contributed very considerably towards the expense incurred by the German fine chemical manufacturer in under-quoting for other British-made fine chemicals and so making their manufacture here economically impossible. An identical method of treatment is applicable to many thousands of essential fine chemicals and complicates the nascent industry in this country; unless a legislative barrier is maintained, any substance—the manufacture of which is undertaken in this country—will be dumped from Germany, the expense being recouped by unduly high charges for fine chemicals not yet made here. It is this circumstance which, in large part, necessitates untiring attention to the development of the fine chemical industry in Britain; the already long list of fine chemicals produced in this country which has been issued by the Association of British Chemical Manufacturers has to be still further lengthened. Owing to the large number of substances concerned, German dumping may confer upon one industrial a financial benefit for which another British industrial will have to pay, and the financial balance must in the end fall against this country. Unfair competition of this kind would hardly arise if we could succeed in convincing Germany that Great Britain is thoroughly determined to possess a powerful and comprehensive fine chemical industry. Many of us believe that the salvation of industry is to be found in Free Trade; Free Trade cannot be established until our competitors are convinced that preferential pricing on a basis independent of manufacturing costs is not a paying proposition.

It has been remarked above that the British war effort effectually proved the absurdity of the German advertising slogan that this country has no genius for fine chemical manufacture; the progress made since the war may well increase our confidence. Other conditions being equal, the fine chemical industry of England can compete on equal terms with that of Germany; but other conditions are not equal, and the dice indeed are heavily loaded in our favour. Whatever the shortcomings of

British institutions—and they are many—those institutions still remain the best in the world. No country enjoys so stable a system of government as ours; our commercial integrity is proverbial; our banking organisation is the most reputable which exists, and London is probably still the financial centre of the world; our scientific men have always led; we have centuries of manufacturing experience behind us, and competent judges have often described the English workman as the best in the world. We enjoy another and a unique advantage; no natural product—animal, vegetable or mineral—can be named which cannot be supplied under highly favourable conditions from some one or other component part of the British Empire.

With all these advantages, and with the sole handicap that a few years are required for the organisation and building up of a complete network of fine chemical industries, it would be disgraceful if we should fail. We cannot fail, if public opinion realises that a flourishing fine chemical industry is a vital necessity to the prosperity of our Empire and insists that national support is given to the young enterprise. We cannot remain neutral in this matter; if we withhold the necessary aid we shall thereby be giving support to the German fine chemical industries and re-establishing in an intensified form the former German control over our staple manufacturing industries.

WILLIAM J. POPE.

MANUFACTURE OF SODIUM SULPHATE.

F. Mauro has described the manufacture of sodium sulphate as carried on at the work of *Gewerkschaft Kaiseroda*, near *Salzungen*, Germany. It really resolves itself into finding an outlet for large stocks of magnesium sulphate. The reaction involved is represented as:—



By mixing magnesium sulphate and sodium chloride at definite concentrations and cooling down by means of compressed ammonia, white monoclinic crystals of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ separate out.—(*Giornale di Chim. Ind. ed App.*, 1922, p. 153.)

THE FLASH POINT OF KEROSENE.

By E. C. CRAVEN AND B. G. BANKS.

The addition of finely divided coal to kerosene may raise the flash point through

three causes, (a) moisture in added material, (b) decrease in volatile constituents, (c) selective absorption of volatile fraction. The sample of kerosene used gave flash point 120°F. , but when treated with 44 per cent. coal dust this was raised to 122°F. , and the same phenomena was observed when the oil was shaken with clay. No change in F.P. occurred when the kerosene was shaken with glass. Further experimental work showed that the low flash point constituent of kerosene is of a gaseous nature, and is probably of an unsaturated type of compound. The raising of the flash point when kerosene is shaken with such materials as charcoal, clay, etc., is due to the selective absorptive capacity of these substances for the light boiling fraction present. The amount of such substances present can be approximately ascertained from the difference between the Abel flash point and the Ormandy Craven flash point (see *J. Inst. Pet. Tech.*, 1922, p. 151).—*J. Inst. Pet. Tech.*, 1922, p. 490.

THE STEEL AGE.

By J. HENDERSON.*

The progress of mankind from savagery to civilisation has been popularly divided into the three Ages, Stone, Bronze, and Iron. That Stone came first is unquestioned, but whether Bronze preceded Iron or not is not quite so certain. There is no doubt as to the birth of the Steel Age, for it commenced with the reading of Bessemer's now historic paper at the Cheltenham meeting of the British Association in 1856. Before going any further it will be advisable to say a few words as to what steel is. Prior to Bessemer's invention the following definitions would serve to distinguish the two materials, wrought iron and steel.

Wrought Iron.—Iron containing practically no carbon, soft, malleable, ductile, easily welded, breaks with a tough fibrous fracture, but cannot be hardened or tempered, and will not carry a cutting edge.

Steel.—Iron containing 0.75 to 1.5 per cent. carbon chemically combined, hard, not easily welded, comparatively brittle, breaks with a close-grained fracture, can be hardened and tempered, and carries a cutting edge.

The introduction of structural steel following on Bessemer's invention brought

into use a material which in its softer varieties could be covered by the above definition of wrought iron. The following is a list of the various materials classed as steel:—

Carbon, 0.05 to 0.10 per cent., dead soft steel, used for smithing purposes, tin plate.

Carbon 0.10 to 0.20 per cent., soft steel, general structural shapes, ship and boiler plates.

Carbon, 0.20 to 0.30 per cent., general structural shapes, joists, axles.

Carbon, 0.30 to 0.40 per cent., ordinary steel castings, light rails.

Carbon, 0.40 to 0.55 per cent., heavy rails, tyres.

Carbon, 0.60 to 0.70 per cent., spring steel.

Carbon, 0.70 to 0.80 per cent., stamping dies.

Carbon, 0.90 per cent., cold setts. This marks the boundary line between the tough steels and the hard cutting steels; 0.90 per cent. carbon is toughest steel that will carry a cutting edge.

Carbon, 1.00 per cent., table knives and cold chisels.

Carbon, 1.10 per cent., drills and large files.

Carbon, 1.35 per cent., saw files.

Carbon, 1.50 per cent., lancets and razors.

This list shows the absurdity of naming the softer varieties steel, as they are so entirely different in mechanical properties from the harder varieties. The term has, however, become fixed, and will probably remain so. In later years other kinds of steel have been introduced known as alloy steels, containing manganese, nickel, tungsten, vanadium, chromium, and molybdenum.

We have no record of when steel was first discovered, but its manufacture was not placed on a definite footing until the introduction of the cementation process early in the 18th Century. This process depends on the fact that if a piece of soft, carbonless iron is heated in contact with charcoal, but air excluded, the iron will absorb carbon from the charcoal which becomes chemically combined with the iron. The resulting product is entirely changed in structure and mechanical properties. The converted bars were made into piles, heated to welding heat, and hammered into bars and were known as shear steel. However carefully made, these bars were liable to be irregular in

composition, and this lack of homogeneity brought about the introduction of crucible steel by Huntsman in the latter part of the 18th Century. He conceived the idea that if the bars could be melted and cast into ingots a homogeneous product would result. After many experiments he succeeded, and crucible steel came into existence. With the exception of the use of manganese introduced by Heath about 1830, the manufacture of crucible steel is carried out in Sheffield in much the same way as in Huntsman's time. It is still the method used for the finer varieties of cutting steels. Before Bessemer's invention engineers had to rely chiefly on wrought iron for structural purposes. Bessemer was an engineer interested in gunnery, and was started on the path which ultimately led to his famous invention by the search for a stronger material for his gun experiments. He knew that in the manufacture of wrought iron from cast or pig iron that oxygen played an important part in the elimination of the impurities of the cast iron, so he first tried the effect of air blown through molten cast iron, relying on the combustion of the impurities to supply the necessary heat to keep the whole molten without the aid of outside heat. The result exceeded expectations, for not only did the combustion of the silicon and carbon of the cast iron provide sufficient heat, but the metal at the end of the operation was actually hotter than at the start. Silicon, one of the chief constituents of cast iron, gives off on combustion to silica 7,830 Centigrade heat units or 14,094 B.T.U., and has this advantage over carbon in that the products of combustion being solid, the heat is retained in the converter and not carried away in the escaping gases. At this stage Bessemer showed his experiments to a friend, who persuaded him to publish the results, which he did in a paper before the British Association at the Cheltenham meeting in 1856. The title of the paper was, "The Manufacture of Malleable Iron without Fuel." The paper created only a mild sensation, and was received by the trade generally rather with incredulity and a certain amount of ridicule, while the British Association thought so little of it that they did not include it in the copy of their proceedings. Nothing daunted, Bessemer and several friends established works at Sheffield to develop the process on a practical scale. Right at the outset Bessemer struck two very serious difficulties. In the puddling process for

making wrought iron the phosphorus in the cast iron is eliminated, and Bessemer quite expected the same would be the case in his process, but found there was no elimination of phosphorus at all. The reason is simple. In the puddling process the slags are basic, rich in oxide of iron, which easily carries off the phosphorus as phosphate of iron. In Bessemer's process there is an excess of silica produced by the oxidation of the silicon of the cast iron, and also derived from the lining of the converter, which was composed of ganister containing over 90 per cent. silica. Thus any base present in the converter charge was all absorbed by the excess of silica, and so no base was available for the absorption of the phosphorus. Fortunately for Bessemer's hopes there was in England, in the Cumberland district, a very fine deposit of hematite ore sufficiently low in phosphorus to produce a pig iron suitable for his process. Thus this difficulty was overcome. Another difficulty was much more serious, and at one time looked as if it would wreck the process. After a charge is completely blown in the converter, the resulting "blown" metal is practically pure iron, and naturally it was expected it would roll as easily as wrought iron; but when the ingots were put through the rolls they cracked and crumbled and behaved exactly like burnt or overheated iron. The cause of the trouble was oxide of iron, probably in a finely divided state, throughout the mass of the ingot. In the midst of their troubles and anxieties over this problem they received most encouraging news from Sweden, where with Swedish pig iron high in manganese excellent results were being obtained. Finally, Mushet patented the addition of manganese to the molten "blown" charge, and this solved the difficulty. Manganese having a strong affinity for oxygen, carried off the oxygen combined with the iron, and passed off in the slag, and so rid the metal of its red-shortness. The manganese had still a further effect, as it also combined with the sulphur present. Sulphur as sulphide of iron has also a red-short effect on the material, but sulphide of manganese has not. There was a third benefit from the addition of manganese, for by adding it in the form of spiegeleisen, a cast iron containing 10 to 30 per cent. manganese and $5\frac{1}{2}$ per cent. carbon, sufficient carbon was added to produce the various grades of structural steel required.

Thus was structural steel born, and it is impossible to estimate the enormous bene-

fit it has conferred on engineering and world communications. In steel rails alone there was quite a revolution in railway progress and development. It would be impossible to run the heavy locomotives of to-day on iron rails, as they would prove too soft to stand the severe demands of modern railway requirements. Not only could they be made cheaper than iron rails, but the output of a single Bessemer converter as compared with the old puddling process was enormous. In the puddling process it took $1\frac{1}{2}$ hours to make $4\frac{1}{2}$ cwt. of wrought iron, whereas the Bessemer converter turned out 10 tons of steel ingots in 20 minutes. In America a pair of converters produced the record output of 2,000 short tons of ingots in 24 hours. The Bessemer process has seen its best days, however, and must give way to the more reliable open hearth steel process. It still survives in the use of small converters for the manufacture of steel castings and also as a preliminary purifier in what is known as the duplex process.

The next development was the invention of the Siemens regenerative steel furnace. With this furnace, Martin, in France, developed a method of steel making which was known as the Siemens Martin open hearth process. It was called open hearth because by means of doors in the sides of the furnace the charge was accessible for inspection and sampling. Martin melted pig iron and scrap on the hearth of the Siemens furnace, and added pure rich iron ore to refine the charge. Being accessible to inspection and sampling, the charge could be watched throughout the refining process, and by rapid chemical analysis was under perfect control. So reliable was the product that Lloyds adopted the Siemens open hearth process for all structural steel for shipbuilding, such as ship plates, boiler plates, beams, angles, etc. As the hearth of the furnace was made of silica sand, there was no elimination of phosphorus, and therefore pig iron low in that element had to be used, and also the quality of the steel scrap had to be known. Naturally iron and steel metallurgists turned their attention to the problem of de-phosphorization in the Bessemer converter. In 1878 Thomas and Gilchrist, two Royal School of Mines men, patented hard burnt dolomite as a lining for Bessemer converters. This material mixed with tar and rammed in position with hot rammers solved the problem as regards a suitable lining of basic character. Messrs. Bolchow, Vaughan &

Co. had just completed a new Bessemer plant at Eston, near Middlesbrough, and under the management of Mr. Windsor Richards undertook the experiments. Middlesbrough pig iron containing $1\frac{1}{2}$ per cent. phosphorus was used. The converter was lined with the hard burnt dolomite mixture, lime was added to the converter charge, and the blowing conducted exactly as in the ordinary Bessemer process. As soon as the carbon had gone blowing was stopped, and all expected to find the phosphorus eliminated. To their surprise and dismay practically all the phosphorus remained in the steel. They tried again and again, and nearly gave up in despair, when Mr. J. E. Stead (now the immediate past President of the Iron and Steel Institute) suggested going on blowing longer. No Bessemer man would have done this, because it had become a fixed rule in Bessemer practice that the blowing must be stopped as soon as the carbon had gone, otherwise the iron would be wasted and so charged with oxide as to be past redemption. The suggestion was tried, and in the extra two to three minutes out came the phosphorus, and the problem was solved. The nit was found that it was as easy to eliminate $2\frac{1}{2}$ per cent. phosphorus as $1\frac{1}{2}$ per cent., and that the higher phosphorus was necessary to take the place of silicon as a heat producer. The slag produced in the converter when using pig iron with $2\frac{1}{2}$ per cent. phosphorus contained 18 per cent. phosphoric acid as phosphate of lime. One would scarcely expect that a phosphate of lime which had been submitted to a temperature of $1,600^{\circ}\text{C}$. or $2,914^{\circ}\text{F}$. would be any use as a fertiliser, but it proved on merely grinding to a fine powder and applied to the land without any other preparation to be a useful manure, and so became a valuable bye-product. Its composition is a tetra basic phosphate of lime. The successful solution of the de-phosphorisation problem in the converter had a wonderful result as regards the development of Germany's iron resources. As that country had no ores low enough in phosphorus for the ordinary Bessemer process (henceforth known as the acid process) and was too far away from low phosphorus ore deposits in other countries, she was practically cut off from the benefits of the Bessemer process, but as soon as the basic process proved a success she hastened to take advantage of it. By this process she

was able to develop her resources, and did so to such an extent that Great Britain was soon overhauled in steel output and left well behind. Germany took second place in the world's output of steel, America being first and Great Britain third. Even in 1913, when the open hearth process had made such rapid strides, Germany still relied on the basic Bessemer for the greater part of her structural steel output. Her total output in that year was 1,8355,000: basic Bessemer, 10,600,000; basic open hearth, 7,330,000; acid Bessemer, 155,000; acid open hearth, 270,000.

The successful solution of making steel from pig iron high in phosphorus advanced the manufacture of structural steel considerably, but there was urgent need for still further development. Iron ores sufficiently low in phosphorus for the acid Bessemer and acid open hearth processes are not very plentiful. Again ores sufficiently high in that element for the basic Bessemer process are also not extensive. But all over the world there are huge deposits too high in phosphorus for the acid processes and too low for the basic Bessemer. To utilise these for steel making required some kind of basic process, which was eventually found by making the open hearth a basic one. The furnace is similar to that used for the acid open hearth, except that the hearth is made of hard burnt dolomite and magnesite instead of sand, and lime is added to the charge to form a basic slag. This process has now been so perfected that it has become easily the premier process in the manufacture of structural steel. It is under the same control as the acid open hearth process, and can in reason utilise almost any kind of pig iron and scrap. Lloyds, who would not look at basic Bessemer steel, and for a long time debarred basic open hearth, now accept the latter steel for ship building requirements. But for the successful establishment of the basic open hearth process structural steel could not have been manufactured in Australia, as the ores of that country are not suited or any other process. South Africa will also have to depend largely on this process, because her ores are in the majority of cases similar to the Australian. In 1905 Great Britain made $3\frac{1}{2}$ million tons of acid open hearth steel. In 1913 the figures were: acid open hearth, 3,500,000 tons; basic, 2,800,000 tons. Since then the latter has grown further, all

the new steel works being practically basic open hearth. In America, in 1905, basic open hearth steel was 7 millions, in 1913 21 millions. In Canada during the war 60 per cent. of the shell steel produced was basic open hearth. Naturally this is only a brief summary of such a huge subject, but before closing, reference should be made to the wonderful assistance science has rendered in the development of the industry. For years it was carried on without any scientific knowledge of what was being done, but now the successful manufacture of structural steel could not be accomplished unless carried out on strictly scientific lines. Steel is made daily in large quantities of any desired composition with a confidence that is marvellous when the difference between the raw materials and the product aimed at is considered.

Now that the South African Government has passed a Bounty Bill to assist in the establishment of the iron and steel industry, it is to be hoped that those responsible will be up and doing, and establish the industry as quickly as possible. We can look forward to the time when all South African requirements of structural steel will be made here, and the surplus sent to less favoured countries. We can also look forward to the time when, before this Society, we shall be having papers on iron and steel problems in general and in South Africa in particular.

* *The Journal of the Chemical, Metallurgical and Mining Society of South Africa*, September, 1922.

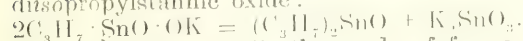
ISOPROPYLSTANNONIC ACID.

By J. G. F. Druce.

*iso*Propylstannonic acid, prepared in a similar manner to ethylstannonic acid (*Trans. Chem. Soc.*, 1921, CXIX, 758), by the interaction of *isopropyl iodide* and potassium hydrogen stannite in accordance with the equation,

$C_3H_7I + KIHSnO_2 = C_3H_7 \cdot SnO \cdot OH + KI$
is amphoteric, forming salts with bases (most of which are basic) and dissolving in hydrochloric or hydrobromic acid to give the tin *isopropyl trihaloid*.

By boiling with excess of alkali-hydroxide solution, the acid is converted into diisopropylstannic oxide:



This reaction recalls the mode of formation of ketones, with which this oxide is analogous, but to which it shows very little

resemblance in physical and chemical properties. When treated with hydrochloric or hydrobromic acid, it yields the corresponding dihaloid.

The di- and tri-haloid derivatives, $(C_3H_7)_2SnX_2$ and $C_3H_7 \cdot SnX_3$, yield double salts with the halogen salts of pyridine. These substances have properties similar to those of the organic stannichlorides (*T.*, 1918, CXIII., 715).

EXPERIMENTAL.

is *Propylstannonic Acid*, $C_3H_7 \cdot SnO \cdot OH$.—The potassium hydrogen stannite solution required was made by adding a sufficient quantity (about 250 cc.) of 10 per cent. potassium hydroxide to produce a clear solution with 20 grams of stannous chloride, shaken with 60 cc. of water. *iso*-Propyl iodide (22 grams) was then added, and the mixture was shaken at intervals during ten days. When the *isopropyl iodide* had disappeared, the solution was treated with dilute hydrochloric acid until neutral, the gelatinous precipitate of *isopropylstannonic acid* filtered, washed with warm water, and dried on a porous plate.

The *isopropylstannonic acid* was an almost white, amorphous substance, which did not melt, but decomposed when strongly heated, leaving a residue of stannic oxide. The acid was anhydrous, and did not gain in weight on exposure to the air. When heated out of contact with the air, it decomposed, giving off *isopropyl alcohol*, propylene, and a trace of propane. The residue contained stannous and stannic oxides and also a little carbonaceous matter.

The acid was insoluble in water and organic solvents, but dissolved in dilute mineral acids and in sodium or potassium hydroxide.

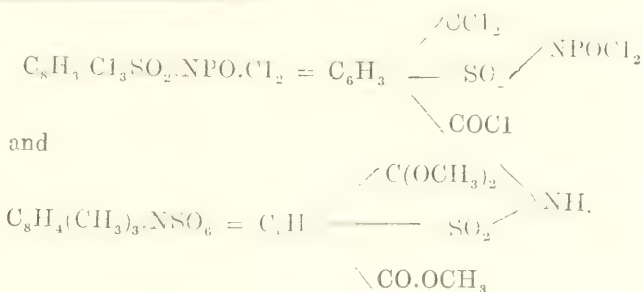
The potassium salt, $C_3H_7 \cdot SnO \cdot OK$, was prepared by digesting excess of the acid (5 grams) with 40 cc. of 10 per cent. potassium hydroxide for several hours on a warm water-bath. After filtration the solution was kept in a desiccator over sulphuric acid until colourless, deliquescent, tabular crystals separated. These were washed with alcohol, drained, and dried between filter-paper. The salt dissolved readily in water, forming a very alkaline solution which became cloudy on keeping and on warming, owing to hydrolysis. With excess of alkali, the solution remained clear.

The sodium salt was isolated in the same way as the potassium salt, which it resembled in its properties.

order. It is insoluble in water, but soluble in alcohol, and melts at 173°C . It is capable of sublimation. *Normal potassium sulphinidephthalate*, $\text{C}_8\text{H}_3\text{NSO}_3\text{K}_2$, is a semi-crystalline body, consisting of a number of opaque spheres. It is soluble in water. *Normal silver sulphinidephthalate*, $\text{C}_8\text{H}_3\text{NSO}_3\text{Ag}_2\cdot\text{H}_2\text{O}$, is a white powder, which is soluble in a hot potassium nitrate solution, but almost insoluble in boiling water.

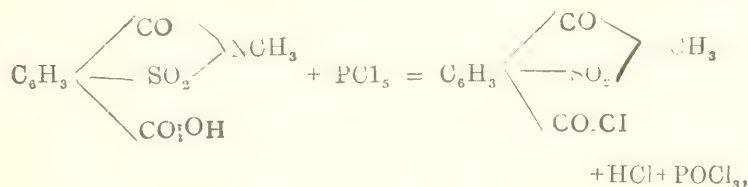
Acid methyl sulphinidephthalate, $\text{C}_8\text{H}_7\text{NSO}_3\cdot(\text{CH}_3)$, is a highly volatile, crystalline body, which takes the form of tablets, or acute, streaked prisms. Its melting point is 192.3°C . In order to produce the

dimethyl ether, it is treated with methyl alcohol and phosphorus trichloride. *Acid potassium sulphinidephthalate*, $\text{C}_8\text{H}_4\text{NSO}_3\cdot\text{K}\cdot\text{H}_2\text{O}$, also takes the form of acute prisms, which become anhydrous at 103°C . This acid salt was used to determine the general constitution of the acid sulphinidephthalates.⁴ It was mixed with phosphorus pentachloride, and the two were heated, this resulting in the formation of the compound $\text{C}_8\text{H}_3\text{Cl}_3\text{SO}_2\cdot\text{NPO}\cdot\text{Cl}_2$, which is a crystalline body consisting of minute prisms. It was converted by methyl alcohol into the trimethyl ether, $\text{C}_8\text{H}_4(\text{CH}_3)_3\text{NSO}_6$, which is also crystalline with a melting point of 141°C . The constitution of these two compounds is as follows:



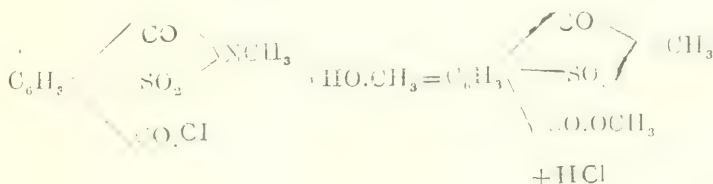
Hence, since the methyl alcohol and the phosphorus pentachloride were responsible for the monomethyl ether and the diethyl ether respectively,⁵ it will be seen that in

the latter case (*i.e.*, that of the diethyl ether), which also bears upon the acid sulphinidephthalates, the imido-hydrogen is replaced in accordance with the following equation:—



and, disregarding entirely the produced hydrochloric acid and phosphorus oxytrichloride,

the final equation is:—



⁴ Roscoe and Schorlemmer.

⁵ Stokes.

The last of this group, α -sulphamido-phthalic acid, $C_6H_3(NH_2SO_3).2(CO_2H)$, is not of such great importance. When it is treated with phosphorus pentachloride and the mixture is allowed to stand, the monochloride, $C_6H_3(ClSO_2).2(CO_2H)$, is produced. This may be transformed into the amide by the action of ammonia.

Acid potassium sulphinidephthalate is more soluble in hot water than it is in cold. Acid silver sulphinidephthalate, $C_6H_3NSO_3.Ag.H_2O$, is likewise crystalline, of the acute pyramid order, which loses its water at $131.5^\circ C$. It may be produced by adding silver nitrate to a boiling solution of acid potassium sulphinidephthalate, the crystals appearing as the mixture cools.

PROCEEDINGS OF SOCIETIES.

THE ROYAL SOCIETY.

THURSDAY, NOVEMBER 23, 1922, AT 4 P.M.

A Special General Meeting was held to consider the annual report of Council.

AT 4.30 P.M.

Papers read:—

DR. T. E. STANTON, F.R.S.: *On the Characteristics of Cylindrical Journal Lubrication at High Values of the Eccentricity.*

J. H. JEANS, SEC. R.S.: *The Propagation of Earthquake Waves.*

PROF. F. A. LINDEMANN, F.R.S., and G. M. B. DOBSON: *A Theory of Meteors and the Density and Temperature of the Outer Atmosphere to which it leads.*

PROF. F. C. THOMPSON and E. WHITEHEAD: *On the Changes in Iron and Steel at Temperatures below $280^\circ C$.* Communicated by Prof. H. C. H. Carpenter, F.R.S.

C. F. JENKIN: *The Fatigue Failure of Metals.* Communicated by Sir Alfred Ewing, F.R.S.

S. BRODETSKY: *The Line of Action of the Resultant Pressure in Discontinuous Fluid Motion.* Communicated by Sir George Greenhill, F.R.S.

DR. R. A. HOUSTOUN: *An Investigation of the Colour Vision of 527 Students by the Rayleigh Test.* Communicated by Prof. A. Gray, F.R.S.

ORDINARY MEETING, NOVEMBER 16, 1922.
Sir Charles Sherrington, President, in the Chair.

The following papers were read, the

summaries here printed having been supplied by the Authors for use at the meeting:—

PROF. A. S. EDDINGTON, F.R.S.: *The Propagation of Gravitational Waves.*

The potentials given in Einstein's theory represent not only the absolute gravitational disturbance of the field, but also the metric of the co-ordinate system which is to a great extent arbitrary; consequently the speed of propagation of the potentials is not necessarily the speed of the absolute disturbance. Einstein showed that, when the co-ordinate frame is chosen subject to a certain restriction, the potentials are propagated with the speed of light.

The present paper considers the propagation of plane waves on unrestricted co-ordinates; and it is found that "transverse-transverse" waves continue to have the speed of light, whereas the other two types of waves have no fixed speed when Einstein's restriction is removed. It is shown that the latter types do not correspond to any absolute disturbance of the field. Of the three conceivable types of transverse-transverse waves, one is inconsistent with the equations of entirely empty space, $G_{\mu\nu} = 0$; but this type nevertheless commonly occurs in nature, viz., as a propagation of gravitational disturbance by light-waves.

Divergent waves are also considered. It is pointed out that, although the equations correspond to those of sound-propagation, no uniform spherical waves of gravitation can occur; they must always be complicated by doublet-sources for some of the components. The waves emanating from a spinning rod are worked out in detail, and it is found that (in agreement with Einstein) the rod must slowly lose energy by these waves; for a typical example the period of decay of the rotation is found to be of the order 10^{35} years.

J. H. JEANS, D.Sc., SEC. R.S.: *The Theory of the Scattering of α - and β -Rays.*

A theory of scattering is developed in which both the feeble encounters of the theory of multiple scattering and also the violent encounters of the theory of single scattering are duly taken into account. It had been hoped that the investigation would disclose some method by which the influence of multiple scattering could be disentangled from observational material, leaving single scattering free for further study, but it has not done so. It is found that the presence of single scattering produces very nearly the same effect as can

be produced by a suitable adjustment of the constants in the law of multiple scattering, and this renders the problem of the separate study of single scattering one of great difficulty experimentally.

PROF. A. P. CHATTOCK, F.R.S., and L. F. BATES: *On the Richardson Gyromagnetic Effect.*

Richardson has shown that the angular momentum arising in a ferro-magnetic substance from unit change in its magnetic moment should have the value of 1.13×10^{-7} if gyrating electrons are responsible for its magnetism. Measurements of this quantity by the ballistic method for three specimens of iron and one of nickel are given in the paper. The results, divided by 1.13×10^{-7} , are collected in the following table under "Ratio":—

Specimen.	Ratio.
Iron	0.507
„	0.501
„	0.500
Nickel	0.505

They agree to within $1\frac{1}{2}$ per cent. with one another, and their mean is 0.6 per cent. greater than 0.500. Close proportionality is also shown to exist between the change of magnetic moment and the angular momentum resulting.

The specimen experimented upon consisted of an upright wire suspended by a quartz fibre. By the introduction of a hinged joint between wire and fibre the important adjustment of the magnetic axis of the wire to the vertical is so much facilitated that measurements were found to be practicable on reversal of magnetism instead of on merely reducing it to zero. The more perfect symmetry resulting from this procedure may be the cause of the more consistent results obtained.

The effect on the ratio of the eddy currents set up in the specimen by its changing magnetism was examined and shown to be not more than a small fraction of 1 per cent. for the specimens used. At high dampings the ordinary damping correction was found to give values that were too large; the error being more noticeable for small than for large amounts of inertia. The effect of this on the measured ratio is shown to be eliminated.

P. M. S. BLACKETT: *On the Analysis of α -Ray Photographs.* Communicated by Sir Ernest Rutherford, F.R.S.

The work commenced by Shimizu of studying the passage of α -rays through gases, by means of Mr. C. T. R. Wilson's

expansion method, was continued. A large number of photographs were taken of the ends of the tracks of α -rays from Polonium in both air and argon. Attention was especially directed to the sudden bends made by the tracks due to collision with the atomic nuclei, and the actual form of these bends was obtained from measurements of the double images given by the special camera designed for the work by Shimizu.

Methods were developed for utilising the data so obtained which related to the frequency of occurrence of bends of given type, and as a result of the calculations the observations were found consistent with the existence of an inverse-square law of force between the α -particles and the nuclei, when their distance apart lies between 6×10^{-12} and 10^{-9} cms. for argon, and 3×10^{-12} and 5×10^{-10} cms. for air.

The velocity of the α -particles along the latter part of their tracks was also calculated from the frequency of the bends and found to be much lower than had been expected. Velocities as low as 10 cms. per second were obtained, and the relation connecting the velocity v and the range r was found to be roughly of the form $v \propto 2\frac{2}{3}$ instead of the form $v \propto 2\frac{1}{2}$ found by Marsden and Taylor for the early part of tracks by other methods. No anomalous effects were discovered as regards frequency or type of collision, as had been suggested by Shimizu.

J. H. JONES: *The Kinetic Energy of Electrons Emitted from a Hot Tungsten Filament.* Communicated by Prof. O. W. Richardson, F.R.S.

This paper deals with distribution of energy among emitted electrons. When allowance is made for experimental and secondary effects the distribution of energy is found to agree with that given by Maxwell's law.

Of experimental errors the most serious are probably due to difficulties of measuring small currents involved and accurate temperatures. These lead to uncertainties which in individual experiments may amount to as much as 10 per cent.

The secondary effects probably arise from contamination of the heated surfaces. This tends to increase apparent energy of electrons emitted and the increase may amount to as much as 20 per cent. In these cases the filament is emitting inefficiently and currents are difficult to saturate.

The abnormal electron energies found by Ting, which were as much as 100 per cent. in excess of the Maxwell distribution value, do not appear under satisfactory experimental conditions.

W. WILSON, D.Sc.: *The Quantum Theory and Electromagnetic Phenomena*. Communicated by Prof. J. W. Nicholson, F.R.S.

From the point of view of the quantum theory such systems as atoms possess stationary states which are subject to conditions expressed by the equations—

$$\oint p_s dq^{(s)} = n_s h.$$

The paper is chiefly concerned with an extended form of these quantum restrictions in which the momenta, p_s , are replaced by more general momenta, π_s , involving the components of the vector potential of the external field to which the system is subjected.

S. MARSH and A. E. EVANS: *On Measurements of Electrode Potential Drop with Direct Current and Alternating Current Electrolysis*. Communicated by Dr. E. H. Griffiths, F.R.S.

Electrodes of polished platinum, platinum-black, gold and nickel were used, normal sulphuric acid serving as the electrolyte. With direct current, anodic and cathodic effects were examined; with alternating current, the frequencies ranged from 25 to 80. Experiments were also made with various current densities. With all the metals examined, the cathodic drop increases with time, the curves (especially with polished platinum) resembling saturation curves in radio-activity. The anodic drop decreases at first and then rises similarly to the cathodic curve. With alternating current the electrode drop decreases during an interval depending on the frequency and thereafter increases slightly.

It is suggested that the cathodic curves represent the effect of occlusion, while the anode curves represent the opposing effects of oxidation and occlusion. An explanation of the effects with alternating current follows on these lines.

ROYAL SOCIETY OF ARTS.

JOHN STREET, ADELPHI.
169th Session, 1922-1923.

Arrangements for meetings during December, 1922.

Monday, December 4th, 8 p.m. (Cantor Lecture): WILLIAM ARTHUR BONE, D.Sc., Ph.D., F.R.S., Professor of Chemical Technology, Imperial College of Science and Technology, "*Brown Coal and Lignites*." (Lecture 2.)

Tuesday, December 5th, 4.30 p.m. (Dominions and Colonies Section): MAJOR OWEN RUTTER, F.R.G.S., F.R.A.I., "*British North Borneo*." (With cinematograph illustrations.) Edward Dent, M.A., Member of the Council of the Society, will preside.

Wednesday, December 6th, 8 p.m. (Ordinary Meeting): H. EMORY CHUBB, "*Recent Developments in the Manufacture of Safes and Strong Rooms*." (With cinematograph illustrations.) Laurence Currie, M.A., J.P., will preside.

Monday, December 11th, 8 p.m. (Cantor Lecture): WILLIAM ARTHUR BONE, D.Sc., Ph.D., F.R.S., Professor of Chemical Technology, Imperial College of Science and Technology, "*Brown Coal and Lignites*." (Lecture 3.)

Wednesday, December 13th, 8 p.m. (Ordinary Meeting): SIR SIDNEY F. HARMER, K.B.E., Sc.D., F.R.S., Director of the British Museum of Natural History, "*The Fading of Museum Specimens*." The Earl of Crawford and Balcarres, K.T., P.C., F.S.A., will preside.

Friday, December 15th, 4.30 p.m. (Indian Section): COMMISSIONER F. DE L. BOOTH TUCKER, "*The Settlements of Criminal Tribes in India*." Sir Edward R. Henry, Bt., G.C.V.O., K.C.B., Inspector-General of Police, Bengal, 1891; Commissioner of Police in the Metropolis, 1903-8, will preside.

THE OPTICAL SOCIETY.

A meeting of the Optical Society was held at the Imperial College, Imperial Institute Road, South Kensington, on Thursday, 30th November, 1922, when there was a discussion on subjects relating to spectacles and spectacle construction.

The meeting commenced at 6 p.m., and there was an interval from 8 to 8.30 p.m., during which light refreshments were served.

The following papers were read:—

"*The design of Spectacle Lenses*," by A. WHITWELL, M.A.

"*Some Recent Developments in Spectacle Lenses*," by W. A. DIXEY.

"*On the Available Means for Correcting Considerable Cases of Anisometropia*," by DR. M. VON ROHR.

"The Best Form of Spectacle Lenses for the Correction of Small Amounts of Anisometropia," by A. WHITWELL, M.A.

"Notes on the Non-Operative Treatment of Squint," by DR. M. B. DOBSON.

"Sir William Crooke's Anti-Glare Glasses," by JAMES H. GARDINER, F.INST.P.

"Standards of Accuracy in Ophthalmic Prescriptions," by O. RAPHAEL.

"Methods used in the Manufacture of Gold-filled Spectacles and Clips," by A. S. RYLAND.

In connection with the meeting, an exhibition of frames, lenses, and all apparatus connected with spectacle fitting and construction was held from 3 p.m. till 8 p.m. Exhibits and demonstrations were given by the leading firms in the industry.

THE GEOLOGICAL SOCIETY OF LONDON.

NOVEMBER 8TH, 1922.

Professor A. C. Seward, F.R.S., President, in the Chair.

The following communications were read:—

"The Earthquake of 7th August, 1895, in Northern Italy," by RICHARD DIXON OLDHAM, F.R.S., F.G.S.

"The Pamir Earthquake of 18th February, 1911," by RICHARD DIXON OLDHAM, F.R.S., F.G.S.

"The Geology of Sierra Leone," by FRANK DIXEY, D.Sc., F.G.S. (Read by Dr. H. H. Thomas, M.A., V.P.G.S.)

A meeting of the Society was held on Wednesday, November 22nd, 1922, when Prof. A. S. Eddington, M.A., F.R.S., delivered a lecture on "The Borderland of Astronomy and Geology."

SOME NEW LECTURE EXPERIMENTS WITH HYDRONITRIC ACIDS AND THE TRINITRIDES.¹

By A. W. BROWNE AND A. B. HOEL.

[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY OF CORNELL UNIVERSITY.]

For the purpose of demonstrating certain of the chemical properties of hydro-

nitric acid and the trinitrides, a number of experiments suitable for use on the lecture table have been devised. These have been tested repeatedly by actual use in lectures given by one of the authors at this University and elsewhere.

1. *Nitridation of Hydriodic Acid by Means of Hydronitric Acid.*—This experiment illustrates the similarity between hydronitric acid (hydrogen pernitride) and hydrogen peroxide.

Five cc. of conc. hydriodic acid (sp. gr. 1.5) are poured into a 15cm. test-tube, avoiding stirring to minimise oxidation, and 1 cc. of a 1 per cent. solution of hydronitric acid is added, whereupon iodine is liberated and nitrogen is evolved. The presence of the iodine is demonstrated by pouring part or all of the mixture into 2.5 litres of water containing starch solution. The reactions may be represented by the following equations: $2HI + HN_3 = NH_3 + N_2 + 2I$; $HI + NH_3 = NH_4I$; and are analogous to those between hydriodic acid and hydrogen peroxide. Nitrous and nitric acids lie between hydrogen peroxide and hydrogen pernitride in composition and character. A blank experiment, in which either water alone or hydrochloric acid is used in place of the hydronitric acid, will prove that the liberation of iodine is really due to the action of the nitridizing agent.

2. *Nitridation of Hydrochloric Acid by Means of Hydronitric Acid.*—While it is scarcely surprising that so powerful a reducing agent as hydriodic acid should evoke the nitridizing power of hydrochloric acid, it is noteworthy that so stable a compound as hydrochloric acid should undergo nitridation with liberation of chlorine. Turrentine² has already shown that hydrochloric acid in presence of hydronitric acid will dissolve platinum.

Five cc. of conc. hydrochloric acid is treated with 1 cc. of a 1 per cent. solution of hydronitric acid in a 15 cm. test-tube, and is heated to the boiling point and held at this temperature for at least 1 minute. This length of time is usually required to effect appreciable nitridation, but excessive boiling may result in loss of the free chlorine. Evidence of the liberation of chlorine is obtained by pouring the contents of the test-tube, either immediately, or after cooling to room temperature, into 2.5 litres of water containing starch and potassium iodide. When water is used in place of

¹ The investigation upon which this article is based was supported by a grant from the Heckscher Foundation for the Advancement of Research, established by August Heckscher at Cornell University. The present paper is Article No. 2 under Heckscher Grant No. 4. For Article No. 1 see *Journal of the American Chemical Society*, 1922, XLIV., 2106.

² *Turrentine Jour. Amer. Chem. Soc.*, 1912, XXXIV., 385-387.

the hydronitric acid, in a blank experiment, the result is negative. The following equations express the reactions involved: $2\text{HCl} + \text{HN}_3 \equiv \text{NH}_3 + \text{N}_2 + 2\text{Cl}$; $\text{HCl} + \text{NH}_3 = \text{NH}_4\text{Cl}$.

The formation of ammonia as a reaction product in Expt. 1 or 2 may be demonstrated by mixing either hydriodic or hydrochloric with hydronitric acid, as just described, adding sodium hydroxide in excess and testing for ammonia with litmus paper or, after distillation, with Nessler's solution.

3. *Formation of Potassium Manganate by the Action of Potassium Trinitride upon Manganese Dioxide.*—The similarity which exists between pernitrides and peroxides of the alkali metals may be illustrated by the conversion of manganese dioxide into potassium manganate which takes place when the dioxide is heated with potassium trinitride (pernitride) in presence of air.

Samples of finely pulverized potassium trinitride and manganese dioxide, weighing 0.5 gr. each are mixed very thoroughly on glazed paper, and the mixture is gently heated in a 100 cc. porcelain crucible, over a low flame, so adjusted as to cause the reaction to take place in from 30 to 60 seconds. During this process the operator should take care not to stand too near the crucible, as the reaction proceeds with considerable violence, accompanied by a hissing noise and by the emission of numerous sparks.

To minimise loss of the reacting material a 200 cc. crucible may be inverted over the 100 cc. crucible before heat is applied, but the smaller crucible should be heated for a few minutes after the reaction has occurred and the larger crucible has been removed, in order to permit the second stage of the process, which results in formation of the manganate, to take place.

In either event, the crucible containing the dark green product is allowed to cool to room temperature, and the contents are treated with about 25 cc. of water. After solution has taken place, the resulting liquid is poured into 2.5 litres of water. The deep green colour soon changes, on standing, to that of a permanganate solution, especially if a small amount of dilute sulphuric acid be added.

The main reaction involved in this experiment takes place in three stages: first, decomposition of the potassium trinitride into its elements; second, reduction of the manganese dioxide by the action of metal-

lic potassium, with formation of manganous oxide and potassium oxide, or possibly of potassium hypomanganite; third, oxidation of the hypomanganite to potassium manganate by means of atmospheric oxygen. These three stages may be expressed by the equations: $2\text{KN}_3 = 2\text{K} + 3\text{N}_2$; $\text{MnO}_2 + 2\text{K} = \text{K}_2\text{O} \cdot \text{MnO}$; $\text{K}_2\text{O} \cdot \text{MnO} + \text{O}_2 = \text{K}_2\text{MnO}_4$.

In the early work on the subject conducted in this Laboratory³ traces, only, of ammonia were detected in the product obtained. Later experiments have shown that considerable quantities of ammonia are formed under certain conditions. Immediately after the addition of a small quantity of water to the residual green product a strong odour of ammonia may be perceived, and the presence of this substance may be confirmed by the usual tests.

The presence of ammonia as a reaction product indicates that the process does not take place entirely in accordance with the equations given above, but that a part of the nitrogen of the potassium trinitride is fixed, probably as a product of nitridation, in the form of a potassium ammonomanganite or manganate, or of a compound that is essentially a mixed ammono-aquo-manganite or manganate.

4. *Detonation of Silver Trinitride with the Aid of a Fuse Composed of Paper Impregnated with Potassium Trinitride.*—A strip from 0.5 to 1.0 cm. wide and from 0.25 to 0.5 m. long, is painted on a large filter paper or paper towel with the aid of a small brush dipped in a 5 per cent. aqueous solution of potassium trinitride. While this is drying, a sample of silver trinitride is prepared by adding, in slight excess, drop by drop, a dilute solution of silver nitrate to 25 cc. of a 1 per cent. solution of hydronitric acid, diluted with an equal volume of water. The flocculent precipitate is collected upon a small filter, and is washed with successive small portions of cold water until the excess of the precipitant has been removed. While still moist, a quantity of the silver trinitride, about sufficient to cover an 18 mm. disc to a depth of 1 mm., is carefully pressed upon the filter paper or paper towel, on one end of the painted strip. If any difficulty is experienced in causing the explo-

³ *Goldberg, Jour. Amer. Chem. Soc.*, 1912, XXXIV., 886.

sive to stick to the paper, a small amount of adhesive may be used, or the solid may be held in place by covering it with a thin piece of filter or tissue paper, glued around the edge. It is important that the paper beneath and around the explosive be treated with a liberal amount of the potassium trinitride solution. After both fuse and explosive have been thoroughly dried, the sheet is suspended from a suitable frame or moulding so that the air has free access to both sides of the paper. When the end of the fuse farthest from the silver trinitride is touched with a glowing splint or with a small flame, the combustion gradually progresses toward the explosive, which finally detonates with a sharp report. Interest in the experiment is considerably enhanced if an appropriate crayon sketch is made upon the paper. For example, an explosive cap may be concealed in the figure of an airplane, while the lower end of the fuse is located at the muzzle of an anti-aircraft gun.

This experiment serves to illustrate (a) the highly explosive character of the heavy-metal trinitrides, which may in general be detonated either by heat or by mechanical impact, and (b) the similarity between potassium trinitride and potassium nitrate when employed in the manner suggested.

When potassium nitrate of corresponding concentration is used for the fuse, the combustion progresses with a velocity about double that noted when the trinitride is used. The paper evidently burns at the expense of the oxygen of the potassium nitrate. With the trinitride, the initial reaction is undoubtedly the exothermal decomposition of the substance into potassium and nitrogen, with subsequent combustion of the free metal, and incidentally of the paper, in the oxygen of the air. While these are the main reactions, it is probable that nitridation accompanies oxidation, at least to a limited extent, as is attested by the presence of ammonia in the products of the reaction.

SUMMARY.

The present article contains a brief description of several new lecture experiments designed to illustrate

(1) nitridation of hydriodic acid by means of hydronitric acid (hydrogen pernitride);

(2) nitridation of hydrochloric acid by means of hydronitric acid;

(3) formation of potassium manganate

by action of potassium trinitride (potassium pernitride) upon manganese dioxide;

(4) detonation of silver trinitride with the aid of a fuse composed of paper impregnated with potassium trinitride.

Ithaca, New York.

—*Journal of the American Chemical Society, October, 1922.*

THE FARADAY SOCIETY.

Papers read Monday, 20th November:—*Intramolecular Ionisation*, by THOMAS MARTIN LOWRY.

The Scattering of Light by Organosols and Gels of Cellulose Acetate, by ERNEST WALTER JOHN MARDLES.

Viscosity Changes Associated with the Gel to Sol Transition, by ERNEST WALTER JOHN MARDLES.

On the Viscosity and Molecular Dimensions of Hydrogen Selenide, by C. J. SMITH, M.Sc., A.R.C.S., D.I.C., Research Student, Imperial College of Science and Technology.

The Hydrogen Concentration of Natural Waters and Some Etching Reagents in Relation to Action on Metals, by W. R. G. ATKINS, Sc.D., F.I.C.

NOTICES OF BOOKS.

Atomic Form, by EDWARD E. PRICE. Pp. 140 + VIII. London: Longmans, Green & Co., 39, Paternoster Row, E.C. 1922. Price 5s.

The author advances a Theory on Atomic Structure with special reference to the configuration of the carbon atom. He assumes that the carbon atom has a definite form, termed a "Carbonoid." The theory affords an explanation for the crystalline structure of Diamond and Graphite, and accounts for Tautomerism and for the existence of optical isomers.

The "carbonoid" itself is assumed to be an *irregular* tetrahedron, and to its special configuration the asymmetry of the chain is due.

With regard to optical activity, it is claimed for the theory that the right and left-handed spirals are displayed by the "carbonoid" aggregates when representing carbon chains, resulting in an asymmetric arrangement like that of an object and its mirror-image.

A chapter is devoted to a possible and ingenious explanation of the polymerisation of isoprene into rubber.

It is difficult to grasp clearly the features of the Theory from drawings alone, resort to models would be more helpful. For this reason, and that discussion would be helpful, the author should consider the advisability of stating his views before a Scientific Society.

On page 15 it is erroneously stated that ethylene is the principal constituent of coal gas, but this does not detract from the value of the volume as a contribution towards the elucidation of the form of the carbon-atom.

Coal and Allied Subjects, by F. S. SINNATT, M.Sc. (Tech.), F.I.C.M.I.Min.E., with the following collaborators: R. A. B., A. Grounds, B.Sc. (Tech.), A.I.C., H. Stern, B.Sc., A.I.C., F. Bayley, M.Sc. (Tech.), A.I.C., M. Barash, M.Sc. (Tech.), A.I.C., W. Harrison, F.C.S., A. McCulloch, A.I.C., May B. Craven, M.Sc. (Tech.), A.I.C. Pp. 205. London: H. F. & G. Witherby, 326, High Holborn, W.C. 1922. Price 15s.

This volume forms a compendium of the first ten bulletins issued by the Lancashire and Cheshire Coal Research Association, and its issue will enable others engaged in Coal Research to share the knowledge and experience gained by the author and his collaborators.

The first is based upon ten introductory lectures on organic chemistry, which are evidently intended for those interested in the study of coal.

The sections which follow deal with sampling, the influence of inert matter upon the yield of volatile products evolved when coal is destructively distilled; coal dust, fusain, etc.

Nearly 40 pages are devoted to the analysis of coal, and this constitutes a valuable portion of the compendium. The method adopted by the Association for determining the calorific value of coal is the subject of the last section.

This compendium contains, therefore, information of considerable value to those concerned with the scientific aspects of the coal industry.



This list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

30103—Appareils et Evaporateurs Kestner.—Pro-

cess of extracting sodiao salts from bicarbonated mineral waters, Nov. 3.

29728—Chemical Eng. Co.—Processes for producing intimate mixtures of substances and obtaining chemical products therefrom.

Specifications Published this Week

- 187347—Wade, H.—Apparatus for making ether.
- 178375—Rushen, P. C.—Process for the reduction of metal oxides by means of aluminium in the furnace.
- 170861—Victoria Iron Rolling Co.—Treatment of tin-plate scrap.
- 172958—Sceib, G.—Process and apparatus for the manufacture of pure nitrogen-carbonic acid mixture from combustion gases.
- 187423—Sams, E. H.—Fertiliser and process of making same.

Abstract Published this Week.

Electrolysts.—Patent No. 185842.—A process for purifying and concentrating material containing tungsten or molybdenum by anodic oxidation, has been evolved by Mr. R. E. Pearson, of Duram Works, Nightingale Rd., Hanwell, London, and Craig, N. E., Beaufort House, Ham Common, Surrey.

If an acid electrolyte is used, the metallic impurities go into solution, leaving the tungstic or molybdic oxide or the metals; if an alkaline electrolyte is used the tungsten and molybdenum go into solution, leaving the impurities. In one example crude molybdenite is crushed to a fine powder and made into a paste with the electrolyte, which may consist of dilute sulphuric acid; it is supported on an anode plate and may be agitated from time to time. Iron and alumina go into solution, and the sulphide of molybdenum is converted into oxide; the molybdic oxide that remains may be separated from the silica gangue which remains by ammonia treatment. A volt-metre, a 25 per cent. solution of caustic soda may be used. In treating wolframe used as electrolyte. The tungsten goes into solution as sodium tungstate, and ferrous and manganese oxides are converted into higher oxides which remain as a sludge on the anode plate. In treating impure tungsten powder obtained, for example, by reduction of the yellow oxide with hydrogen, sulphuric acid of specific gravity 1.2 is used as electrolyte. The paste is introduced into a porous pot in which an anode of platinum wire is inserted. The cathode is a stout rod of lead. A current of 5 amperes at 5 volts is used. The current density at the anode is kept low to prevent excessive oxidation of the tungsten. It is stated that soda crystallises out on the cathode. The contents of the anode pot may, after the reaction, be transferred to the cathode compartment of another cell, the cathode in this case being a group of nickel-chromium rods and the anode a rod of lead. Any tungsten oxidised during the anode reaction is reduced by this treatment, and arsenic and sulphur are removed; soluble silica passes into the solution. The contents of the cathode pot are washed and dried and reduced by hydrogen, and may then be compressed into bars and sintered. Oxalic acid may be used as electrolyte when sodium is the main impurity; hydrochloric acid when iron is the main impurity, and sulphuric acid when carbides are present; these electrolytes may be used successively. Specification 181,837 is referred to.

Messrs. Rayner & Co. will obtain printed copies of the published Specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3269

SOUTH AFRICAN CHEMICAL
INSTITUTE.*

PRESIDENTIAL ADDRESS.

George Hardy Stanley, A.R.S.M., F.I.C.

On this, the second occasion on which it has been my privilege to deliver to you a presidential address, it is fitting that I should commence by expressing the gratification I feel at the honour done me in again electing me President; and more especially because my year of office is the first of our existence as a Chemical Institute.

If that year will not be such a pleasant memory as the previous one, 1913-14, it is certainly not the fault of the Institute, but of the times and trials through which the whole community has passed; and, considering the conditions obtaining, we may well congratulate ourselves on showing a small advance in membership and assets when a retrogression could scarcely have occasioned surprise. We have, indeed, made steady progress from the commencement, and have trebled our membership since 1914.

The general financial stringency, and preoccupation with other affairs, has hampered us to a great extent during the past year; more, I think, than will be gathered from the Council's report, and among other things the Private Bill has had to be postponed till some way can be devised for lightening the financial burden involved. No doubt, also, these factors have been responsible for the dearth of activity in connection with subjects for chemical research, in which direction not a single suggestion has so far been made.

We have now come to the end of the tenth year of our corporate existence, which seems to indicate this as an appropriate time at which to take stock of the position, not only of our profession, but also of the industry with which many of us are directly associated, and all indirectly concerned. And if, in doing so, one finds it easy to be pessimistic, a glance at possibilities of future expansion may act as anti-

dote. I have therefore selected as my subject,

"SOUTH AFRICAN CHEMICAL INDUSTRY AND
ITS FUTURE."

When I addressed you eight years ago I spoke in blissful ignorance of the proximity of the cataclysm which so shortly thereafter convulsed the world, and one point I endeavoured to emphasise was the general ignorance with regard to the nature of the chemist's calling. To-day there is no excuse for such a state of affairs. The prominence into which chemistry was brought in connection with modern scientific warfare ought at least to have given it all the advertisement required, and certainly great appreciation of the services of chemists was freely expressed.

But unfortunately the public is possessed of but a short memory, and already, as in other directions, forgetfulness is apparent, and there is danger that the utility of chemistry in the arts of peace, which seemed likely as a result of war to become more fully recognised, will not receive that recognition to which it is entitled. On the contrary, rule of thumb methods still prevail, and many industries which ought to employ chemists in connection with their operations still continue their penny-wise and pound-foolish policy.

In my opinions, there ought to be more chemists employed, or at least more chemical advice obtained than is at present the case, in connection with the manufacture of foodstuffs of all kinds, the clay industries, the leather industry, and paint manufacture, to mention only a few. This, of course, would largely increase the field of employment for chemists, whose profession at the present time may justly be regarded as overcrowded.

This, however, appears to be a world condition, and I have for the purpose of this address endeavoured to form an idea of what are the possibilities of expansion of the chemical industry in the Union, and hence of the chances of an increased demand for chemists. In Great Britain, the Institute of Chemistry has a total membership of about 4,500, which is equivalent to about 113 per million of population. Our total membership, on the other hand, is only equivalent to 88 per million of our white population, or say 22 per million of the whole, so as our chemical output per head progresses towards the British total, evidently a considerable increase in the number of our chemists may be anticipated.

* *Proceedings of the South African Chemical Institute, Special General Meeting, 25th March, 1922.*

That expansion is possible and also probable has been the theme of others of our presidents, but I make no excuse for returning to it to-night in view of the admitted and urgent necessity for industrial development. I shall, however, attempt to give concrete expression to the possibilities by quoting actual figures involved, and I trust that you will not only not find them "dry," but as interesting, and often surprising, as I have myself. But it is obviously impossible to go very far into details of individual industries within the limits of an address, little more can be done than to indicate points of attack.

It is difficult to assign even an approximate date to the beginning of chemical industry in this country, and if smelting of metals and brewing of beer be accounted chemical operations, it had its dawn, as elsewhere, in the mists of antiquity. But after the advent of Europeans the manufacture of wine, brandy, vinegar, leather and lime-burning appear to have been the earliest with which chemistry is concerned, though probably the originators were not aware of it.

Wine manufacture was established by the Huguenots in 1688, but did not attain any importance till about 1813, and some other dates of interest are the following:—

Petersen's established in 1842.

Mossop's tannery in 1846.

Sugar produced in Natal in 1850.

Copper in Namaqualand in 1852.

J. J. Hill, confectionery, 1868.

Ohlsson's Cape Brewery, 1889.

Cyanide Process introduced, 1890.

Cape Explosives Works made collodion cotton in 1903.

Carbon dioxide manufactured from magnesite, 1906.

As the needs of the population grew, chemical requirements were, of course, imported, and apart from those already mentioned, the establishment of industries definitely chemical in character, and needing the services of chemists, was comparatively recent.

To-day, fertilisers, soap, candles, cement, explosives, sugar, and alcohol are produced in considerable quantities, and as indicating how one great industry benefits others, I may quote the values of some of these products used as stores by the mining industry in 1920, that industry, I may remark being itself absolutely dependent on a chemical process—cyaniding.

Candles	£420,000
Cement	£93,000
Explosives	£2,065,000
Lime	£150,000
Soap	£20,000

In addition the wine, brewing, and dairy industries are all responsible for respectable outputs.

Unfortunately, only a few of these industries utilise entirely South African raw materials, but at least they all employ local labour, fuel and power, and in the result keep in the country to assist in further development capital which would otherwise go overseas.

I do not want to drag you along the thorny pathway of fiscal controversy, but I would like to urge that it would be in the best interests of the country to manufacture here the maximum possible amounts of our requirements of essentials, *i.e.*, food, housing, and clothing, for which we are at present much too dependent on overseas sources. We should take in return for our exports of gold, diamonds, coal and agricultural products, raw materials and machinery for our own industries, as well as other highly specialised products of overseas countries, motor cars, typewriters, pianos and articles of luxury which a population, as a result of this policy considerably increased in numbers and with improved standard of living, might reasonably be expected to demand. To conduce thereto, local industries should be encouraged by any and every legitimate means, and in their growth chemists will, of course, play their part.

The results of the industrial census show that the manufacturing industries now established in the country are, in the aggregate, of quite unexpected magnitude, and in a very considerable number of them we, as chemists, are or should be more or less closely concerned.

For statistical purposes they are grouped into a number of classes, those in which we are interested being:—

(I.) Raw materials; this includes tallow production, but is so miscellaneous in character that figures in connection with it are for our purposes useless.

(II.) Stone, clay, etc., in this is included cement, lime, salt pans and salt works, glass, brick and tile, etc.

(V.) Foods, etc., which includes sugar, brewing, etc.

(XI.) Chemicals, including explosives, fertilisers, oils, paints, soap and candles, etc.

From these I have extracted the following figures, which enable the importance of these industries to be gauged.

1919-20.

	No. of Factories.	Value of Land and Buildings.	Value of Machinery and Plant.	No. of Employees.
Class II.	354	£737,476	£1,113,010	13,463
Class V.	1819	£4,459,324	£4,610,879	32,958
Class XI. ...	108	£1,643,445	£2,176,080	9,160
		Value of Materials used.	Value of S.A. Material.	Value of Production.
Class II.		£635,982	£318,023	£2,407,077
Class V.		£25,046,356	£21,480,976	£35,137,533
Class XI. ...		£4,862,459	£1,518,132	£7,345,765

In addition, the value of the outputs of some specified industries is as follows:—

Grain Mills	£12,631,000.
Jam factories, sweets, etc.	£2,132,000. (sweets £1,150,682).
Breweries	£1,895,000.
Butter and Cheese	£1,498,000.
Brick, tile, earthenware and pottery	£742,000.
Lime Works	£247,000.
Tanneries	£1,394,000.
Soap and Candle Factories	£3,010,000. (including certain chemicals).
Soap	£1,616,000. (Raw material, mostly imported, £2,312,003).
Candles	£1,030,963.
Salt	£197,068. (nearly 90,000 tons).
Sulphate of Ammonia	£63,088 (nearly £103,000 in 1919).
Tar	£3,382.
Arsenic	£655. (£1,759 in 1918).
Antimony	Nil. (£15,292 in 1916).
Copper	£418,000. (£1,126,040 in 1917).
Gypsum	probably £5,000 to £10,000.
Iron Pyrites	£5,014.
Lead	£5,270.
Magnesite	£3,780.
Soda	Nil. (£29,377 in 1917).
Mineral Paints	£1,049.

(It will be noticed that several items show decreases recently.) In Class II. a considerable variety of products is made in addition to those already mentioned, *e.g.*, acids, ammonia, arsenate of lead, barium nitrate, calcium carbide, caustic soda, charcoal, coke, copper sulphate, cattle and sheep dips, disinfectants, epsom and glauber salts, ether, ferric and ferrous sulphate, glycerine, matches, nitrate of lead, oils, greases, wax and tallow, paints, varnishes and distempers, perfumes, photographic papers, rubber goods, soda (washing, bicarbonate, arsenite, bisulphite and sulphide), tar and pitch, wattle bark extract.

Doubtless a few large concerns are responsible for the bulk of the output of each product, but with respect to the numbers of producers I find the following:—

- 20 manufacturing chemists (probably chiefly pharmaceutical).
- 13 chemical manufacturers.
- 4 or 5 acid works.
- 2 industrial alcohol producers.
- 14 breweries.
- 5 candle factories.
- 61 cattle feed makers.
- 3 cement works.
- 8 coke producers.
- 13 disinfectant manufacturers.

- 22 distillers.
- 3 explosives factories.
- 37 fertiliser works.
- 31 lime works.
- 14 oil and grease works, 3 edible oil producers, 4 tallow refiners.
- 18 paint, varnish and distemper producers.
- 5 rubber goods manufacturers.
- 50 salt works.
- 17 soap works.
- 10 soda compound makers.
- 30 sugar mills and refineries.
- 34 tanneries.
- 3 tanning extract makers, 26 wattle bark grinding and compressing.
- 12 tar and pitch.
- 20 wine, brandy and spirits.

Now as regards the chemist, undoubtedly a large proportion of the output of some of these industries is produced under skilled chemical control, but that is the result of the operations of a few large firms previously referred to. A large number of concerns employ no chemists at all, nor do they sufficiently avail themselves of the services of chemical consultants or analysts in private practice. But this is by no means characteristic of South Africa alone, and we can only hope that the benefits to be derived from a closer association between industry and science will become more fully understood and seen to be mutual.

Probably between 100 and 150 chemists are employed in industries or as consultants, and the amount paid for chemical assistance is probably much less than one-half per cent. of the value of the output. Just compare that with the size of the advertising bill!

I feel that I have said enough with regard to the present position.

If the progress which has been made is not quite what has been hoped, at least chemical industry has attained considerable importance and may reasonably be expected, in spite of such drawbacks as heavy railway charges and the sparse settlement of the country, to go on making steady progress as the country develops and the needs of its population increase.

Future possibilities may be considered from two aspects:—

(1) Meeting the needs of the South African population, *i.e.*, the local market.

(2) Working up South African raw materials for export.

Under (1) what chemical products does the Union need? Which are made here and which imported? And what possibility of expansion is thus indicated? A consideration of figures affords much information.

The list of producers previously given shows how diverse our requirements are, and we may perhaps turn again to the mining industry for some indication of the importance of the various items.

It may be urged that the gold mining industry in the Union has passed its zenith, and this is possibly true, but for a long while to come the stores it needs are not likely to appreciably diminish, and it is more than probable that any diminution in the largest item, explosives, will be counteracted by the more extensive use of dynamite in coal mining and agriculture. Meanwhile, its other requirements, at present largely imported, afford an indication of the direction in which expansion of the chemical industry can occur. Referring again to the figures of consumption in 1920 we find the following in addition to those previously quoted:—

Carbide	£135,000
Cyanide	£376,000
Disinfectants	£25,000
Lubricants	£375,000
Paints, etc.	£39,000
Iron	£150,000
Steel	£664,000
Antifriction metal	£32,000

The figures of imports into the Union are still more impressive, and open up the prospect of a chemical industry of considerable magnitude.

IMPORTS, 1920.

	£
Metals and Minerals	nearly 4,000,000
Oilman's Stores	4,384,000
Manures and Fertilisers	240,000
Sheep Dip	161,000
Dairy Products (including condensed milk, £600,000)	953,098
Pickles, sauces, etc	222,000
Wines and Spirits	891,000

Raw Materials—

Iron and Steel	3,256,850
Nitrates	202,000
Sulphur	62,000
Tar, Bitumen and asphalt	121,000
Tin	17,000
Zinc	108,000
Glycerine	538,000
Wax, paraffin and stearine	813,000

Manufactured Articles—

Antifriction grease	112,000
Fencing Material	1,153,917
Oils	3,041,950
Paints and painters' goods	617,000
Soap	135,000
Cement	134,000
Drugs, chemicals and medicines	1,545,000
Earthenware and chinaware ...	528,000
Indiarubber goods (including tyres)	1,403,719
Perfumery	308,000

It is a coincidence that the alphabetical juxtaposition of the first two items in the mining requirements is scarcely closer than their chemical association. Cyanide, as you are aware, can be produced by fusion together of salt and cyanamide, itself produced from carbide, and the process is in commercial use in the United States.

Investigations were carried out here in the early days of the war, when the position as regards cyanide supplies gave cause for anxiety, and it was found to be quite a feasible method of production. However, supplies of cyanide became assured, and no further steps were taken to establish local manufacture.

At that time, too all the carbide used was imported, and under war conditions became sufficiently expensive to render its local manufacture an attractive proposition. To-day two carbide furnaces are successfully at work on the Rand. Indeed, I ought perhaps to have mentioned this commodity as among those manufactures already established. There is, in addition, a plant being installed in Natal to make carbide and ammonium sulphate.

But the local manufacture of cyanide has yet to be initiated, and in view of the value quoted appears to be well worthy of consideration, more especially as the mining industry will not be the only consumer.

Its use for fumigating habitations is perhaps unimportant, but agriculturally it is being increasingly used by orchardists, and no doubt will in time be required in quantity.

As compared with that produced by overseas waterpowers, electricity is still expensive here, but for interior markets this is neutralised more or less by the cost of transport from oversea, which also has to be regarded as an offset to any increased production costs incurred by the probable relatively small scale of operations.

For cyanamide itself there is bound to be an increasing consumption, whether cyanide is made from it or not, in agriculture.

In Europe in 1913, 260,000 tons of cyanamide was produced, and as this country goes in more and more for intensive farming, consumption of fertilisers must increase, and hence also the demand for cyanamide.

In due course ammonia and nitric acid will also be made from cyanamide, and, it may be, enable our explosives industry to free itself from any suggestion of being a "bastard" industry, because it operates on imported raw material.

In the direction of disinfectants, medicines, etc., the mines obviously only consume a small portion of the present imports, and the total value is considerably greater. However, there is at present a considerable production of medicines in the Union, and the field for expansion is not large. The case for disinfectants is rather different, in which connection imports appear to bulk more largely, and which offer more prospect of increased South African production.

Lubricants constitute another very important group of materials, practically the whole of which (or raw material therefor) is imported, and I presume in the main consists of mineral hydrocarbons, with which, so far as is now known, we appear to be naturally poorly supplied. Certain vegetable and animal oils, however, are also valuable as lubricants, and though in general too high priced elsewhere, they may possibly in future be cheaper here.

There is, of course, every probability that our considerable deposits of oil shales will be turned to account and a further source of oil will lie in the development of coal carbonisation processes, in which a start has already been made, besides town gas works, by the erection at Witbank of retorts, and of a battery of Coppeé ovens at Dundee in Natal. These ovens are expected to produce benzol also, which is possibly the best motor fuel, and which, in admixture with alcohol, may render South Africa independent of imported petrol, as it is now independent of imported coke.

The need for tar, creosote, etc., increases the already bright prospects of the coal by-products industry.

Iron and steel I have dealt with elsewhere, and it will suffice to say here that all the raw materials exist on the spot, and have been proved by the experimental

smelting of about 2,000 tons of pig iron, and that probably 175,000 tons annual production could be absorbed by the local market.

There has been deplorable delay in establishing this key industry, and as you have seen, the Government has recently announced a definite policy of encouragement, and besides contracting for half the railway requirements, has offered a bonus. So many other industries are subsidiary to this that we devoutly hope the Government efforts will be successful at no distant date. An importation valued at practically 4½ million sterling, which could largely be made here surely offers sufficient scope.

The iron industry will also assist in the direction of phosphatic fertilisers, in which the Union is naturally deficient. Nitrogen has already been mentioned, but the potash position is still indefinite. It is known, however, that we have large deposits of felspar rich in K_2O , and this can be extracted, at a cost which it may be worth paying, even if rather higher than that of importation.

It would take too long to deal with all the other items, I am afraid, but the rubber industry, with which a commencement has been made in Natal, is worthy of at least a passing mention. In the Howick factory a raw material from tropical Africa—rubber—is already being manufactured into goods, including motor tyres, and here obviously there is also room for expansion on a considerable scale.

Lastly, I would refer to the sulphuric acid industry, the key to so many other chemical industries, and in which it is a matter for concern that the country has not so far been able to meet its needs of the chief raw material, sulphur. Much less than half is, in fact, furnished by South African sulphur bearing material—pyritic concentrate, but I think there is hope for the future in the development, with improved transport, of several pyritic ore-bodies now difficult of access, particularly of those which are also nickel or copper-bearing.

I have already kept you too long, but export possibilities may next receive some attention.

There is in this connection a factor which has not so far received sufficient consideration, but which will, I am sure, become of the utmost importance in the future, and that is the rapid development of the, as yet, undeveloped portions of Africa. Im-

portant mineral discoveries, the usual fore-runners of European activity, have already been made, advances in medical science and improvement in transport facilities are rendering accessible vast areas which may be regarded as our natural markets, to which we shall supply manufactured articles, and from which we shall draw raw material.

The figures hereunder, of exports during 1920, show that, in addition to exporting raw material, some at least of which could receive further treatment before export, a beginning has already been made in the exportation of manufactured goods.

EXPORTS, 1920.		£
Aloes		15,000
Argol		8,000
Wattle Bark		986,000
Buchu leaves		67,000
Maize		344,000
Raw Cotton increasing very rapidly)		70,000
Hides and Skins		4,218,755
Wool		16,000,000
Sugar		456,000
Molasses and Treacle		82,000
Ale and Beer		36,000
Salt	tons	1,375
Blasting Compounds		243,000
Candles		15,000
Confectionery and jams		150,000
Drugs		13,000
Manures		74,000
Soap		42,000

This I find especially encouraging.

We have all no doubt had the experience of hearing how impossible it would be to make such and such a product in the country, let alone export. In my own experience I need only mention the smelting of tin and local manufacture of cast steel shoes and dies, now accomplished facts. To go further back, I once came across a carefully reasoned statement, which proved beyond doubt that a railway between London and Birmingham was chimerical, and in any case could never pay.

Personally, I prefer to consider all things as possible, and in view of the rapid advances in all directions which have taken place even within our own recollection it is indeed a bold man who would in almost any connection predict impossibility wherever probability is shown. Improbability is quite another matter.

To resume, there are in my opinion a few outstanding possibilities in connection with exportation of the products of "chemical" industries, though it must be borne in mind that many countries, while admitting raw material free, impose protective duties on products manufactured therefrom. (In view of this position already existing whence comes the danger of inviting retaliation if we do likewise? Rather would we provide ourselves a counter to bargain with.)

It will be observed that both hides and wattle bark to tan them with are exported in large quantities. On the other hand, South African sole leather at least is of proved excellence—the inference is surely obvious!

Maize again is largely used overseas as a raw material for manufactured products—among which I have heard whisky mentioned—and our small beginnings in that direction should lead to big things. We should export and not import starch and glucose.

Cotton is an item which grows rapidly in importance year by year, and has every prospect of a brilliant future. Cotton seed oil and cake are elsewhere very important by-products, and must inevitably increase in quantity here. Wool to-day is largely exported "in the grease." It is true wool washing is already a South African industry, but it appears to be capable of considerable growth and extension in scope, so as to produce lanolin, potash, etc. The sugar industry will probably increase its export of wax and alcohol, and the other manufactured products imported are all likely to increase in amount as the interior of the continent is opened up; in addition, there are great possibilities in connection with vegetable oils and their products, including edible ones.

Among food products a more scientific conduct of the wine and spirit industry—unless prohibited—will increase overseas demand with improved quality, and the growth of apple orcharding may well result in production and export of cider; other orchards will furnish raw materials for fruit essences, citric and tartaric acids, and essential oils will be prepared also—*vide* eucalyptus, peppermint, lavender, to mention only a few sources which flourish somewhere or other in our variety of climates.

The development of the meat industry will lead to canning factories, and the production as side lines of glue, gelatine, tallow and fertilisers; dairying similarly to

casein and milk sugar, though it is doubtless a far cry at present.

In concluding, I will deal briefly with the mineral and metallurgical side. I think the chief chances of establishing an export trade in metallurgical products is in connection with ferro-alloys—the products of electric furnace smelting in which high cost of power is largely balanced by saving in freight. Ferro-chrome could certainly be made here from our chromite; in view of the probable costs and oversea selling price, it is probable that it could be profitably exported.

Ferro-vanadium is another probability. It has been found that our immense deposits of titaniferous iron ore carry appreciable amounts of vanadium, and its commercial extraction is, I feel certain, only a matter of time.

Ferro-tungsten is more doubtful, but promising occurrences of scheelite are known, and as this mineral is one likely to escape the notice of the average prospector, systematic search may reveal much larger supplies.

Molybdenum also has been reported in several places, and from information I have will probably be found in time to justify exploitation.

I think I have said enough to show that, although its growth may not be spectacular, the hopes entertained regarding the future of chemical (and metallurgical) industry in South Africa, to which I have endeavoured to give quantitative expression, have not been lacking in foundation; and that it has every probability of being prosperous. May we all share in the rewards, as we assuredly will in the toils, of the advance.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Section I.—Physiology.

THE EFFICIENCY OF MAN AND THE FACTORS WHICH INFLUENCE IT.

ADDRESS BY PROF. E. P. CATHCART, M.D.,
D.Sc., F.R.S., PRESIDENT OF THE SECTION.

(Continued from Page 318.)

It can be shown that if a certain distance has to be covered in a definite time there is an optimum rate of forward progression. Cathcart, Lothian, and Greenwood found, for example, that when the cost per mile alone was considered, the minimum value was reached at a rate of about three miles

per hour, but when the question of time as well as distance arose, *i.e.*, if a distance of, let us say, one mile was to be covered and sixty minutes were available to do it in, would it be more economical to march the mile rapidly or slowly and have a longer or shorter period of rest? Our experiments showed that the lowest hourly value was obtained at a rate of a mile in about 23 minutes, *i.e.*, marching for 23 minutes in the hour and resting for 37 minutes. To spend 32 minutes on the march cost about 5 per cent. more, and to reduce the marching time to 16 minutes increased the cost by about 15 per cent.

So much, then, for the ordinary effector factors. There are many other factors directly concerned with the efficient action of the organism, some directly influencing the internal economy of the body, others acting more indirectly on the organism from the environment.

One of these factors is the state of the nutrition. It may be definitely stated that an insufficient intake of food or the consumption of poor or inadequate food is one of the chief sources of general inefficiency. Our resistance to the effects of hard and continual work, just as to the effects of an infection, is largely controlled by our reserves. The capacity of the body to store reserve food material which will meet the daily demands for energy and leave a surplus is another of the vital factors of safety. The body is undoubtedly capable of withstanding complete deprivation of food for comparatively long periods, but with a corresponding depression in its capacity to perform external work. Complete starvation is a state which is rare, and does not affect the question at issue. The much more important problem is unfortunately only too common, the influence of chronic undernutrition, a condition which lowers efficiency, not merely in the actual performance of muscular work, but by inducing an increased susceptibility to disease. This is a question which has never received the attention which its importance demands, largely on account of the immense difficulties of carrying out the investigation in a practical manner. As the direct result of the war we have the records of at least two sets of observers. Benedict and his co-workers investigated the problem, using a group of twelve men, comparing them with a similar group drawn from the same class. In the experimental group the food intake was reduced, so that there was a loss of 12

per cent. of the body weight. Although the experiment was carried on for over four months, and the basal metabolism was reduced by 18 per cent., the diminution in muscle power, so far as laboratory tests were concerned, was not great. The subjective impression, however, of the subjects was that they felt weaker and less capable.

The other recorded experiment is that of the condition in Germany during the war years. A general statement of the effects of the blockade is contained in a long document prepared by the German Government (dated December, 1918). Admittedly the document was prepared for a specific purpose; but, after making all allowances, the record of the far-reaching effects of chronic underfeeding is valuable. It may be remarked that many of the statements receive corroboration in the report drawn up by Professor Starling on the food conditions in Germany. Apart from the increased death rate, the increased liability to disease, and the slow recovery from the attacks of disease, the document definitely states that the working capacity of the people was reduced by at least one-third. The following sentence gives probably an accurate picture of acute undernutrition, associated, it is true, with much emotional strain: "Everywhere in Germany it may now be observed how, in the four years' struggle for daily bread, the people have lost all their vigour and capacity for work; how all spirit of enterprise is gone."

Here, then, we have the actual record of an experiment on a gigantic scale. Personally I believe that these results are much more likely to be the ordinary sequence of underfeeding than the laboratory results of Benedict. I do not doubt for a moment his records, they are beyond reproach; but I feel that many of the excellent results which were obtained when the test subjects competed with subjects on ordinary food were in part due to the quite natural desire of the men to demonstrate to their friends and the onlookers that they were fit. In other words, there was a strong psychic element which vitiated the test as a real test for efficiency.

Evidence, much debated it is true, would indicate that it is not only the quantity but the quality of the food consumed which plays a part in the fitness of the individual to perform hard muscular work. All modern work would seem to point to the conclusion that if the caloric value of the food sup-

plied is adequate the actual demand for protein is very small. It is very difficult, however, to believe that the far-reaching common belief in the efficacy of a high meat intake, despite the scientific evidence to the contrary, is without some foundation. It is possible that the value of meat (flesh) depends not merely on the high biological value of its protein, but also on the fact that it can act as a stimulant of cellular activity; that, in other words, it is desired for its stimulating effect, for giving, in that expressive transatlantic word, "pep."

Another factor which plays an enormous rôle in the general efficiency is the response of the organism to the multiple psychic imponderabilia which compose such a large part of the average environment. Although for general purposes, such as the calculation of mean or average demands, it may be both convenient and useful to assess the data on an average man basis, yet it is the individual variation which controls the actual operating conditions. When we are dealing with the efficiency of the human organism, male and female, we are dealing with individuals whose performance is neither uniform throughout the year nor from week to week, nor even from hour to hour. We have to deal with an organism, as I have already mentioned, which is not only under physical control, but is very responsive to physis influences—an organism which not only becomes in the course of the day physically "tired," but which unconsciously is influenced to an enormous extent by its environment, by its "atmosphere." Man is, in the main, a psychic chameleon.

In this connection monotony of work must be considered. The Health of Munition Workers' Committee stated that monotony is "analogous to, if it does not represent, a fatigue process in unrecognised nerve centres." It is true that monotonous work, be it light or heavy; may be, as Goldmark maintains, "more damaging to the organism than heavier work which gives some chance of variety, some outlet for our innate revolt against unrelieved repetitions." Still, although there may be a close relationship between monotony and fatigue, as generally recognised, they are not identical. The temperament of the operative plays an enormous part in the determining whether or no any particular operation is a monotonous one. Thus a skilled engineer put on to attend an auto-

matic machine which requires the minimum of skilled attention would soon be disgusted with the monotony of the operation even if the pay were good, whereas an unskilled worker, especially if of a lower degree of intelligence, could attend to such a machine without strain. Munsterberg has recorded a number of most interesting examples of this seeming imperviousness to monotony even on the part of apparently intelligent individuals. Probably, indeed, if the operation is a slow one, or, if quick, one in which the movements are relatively simple, the dull individual—the organism with few trained receptors—and the worker with intelligence above the average, who readily masters the performance and can then let his mind free to speculate on his own private interests, will stand the strain better than the worker of average intelligence. As Munsterberg has shown, it is extremely difficult, if not impossible, for an outsider to determine what a monotonous operation is. It is obvious that if A is interested, let us say in epigraphy, he will judge that B, engaged in some simple routine stamping or packing job, is employed on a monotonous operation, whereas it would be equally likely that if B were asked his opinion he would candidly state that he would not exchange his interesting work for the dull and monotonous pursuit of A.

There are many other factors which play a definite and important rôle in the maintenance of efficiency, such as lighting, heating, ventilation, the mode of life led by the worker outside his definite hours of labour, his housing, &c. Many of these factors have been partially examined. Thus Leonard Hill has carried out a great deal of valuable work on the influence of the cooling power of the air. Vernon has collected much interesting evidence which shows that there is a very definite relation between the efficiency, as measured by output, and the temperature of the working place. The output in the hottest weather was about 30 per cent. below that when the weather was coldest. He also observed an apparent connection between the relative humidity of the air and the efficiency of the worker. The efficiency, as might have been expected, was apparently greatest when the relative humidity was low. Elton has reported on the influence of lighting in silk weaving. He found that the output was lowest when artificial light was used. He stated that even when electric light of sufficient intensity was used, the output was

about 10 per cent. below the daylight value. The actual equipment of the factories, the provision of seats of suitable size, height, &c., the design of the machines, and so on, all play their part, as is shown by the many records, particularly from the United States.

In other words, the real overall industrial efficiency of the worker cannot be casually related to any single factor. It is not the mere capacity of the individual to perform so many kilogrammetres of work in a given time with the smallest expenditure of energy. The quest of efficiency is one of the most intricate problems in its infinite ramifications throughout the physiological and sociological structure which has ever called for solution, and it involves the whole welfare of our race and nation. It calls for the closest and most intimate co-operation between the scientific investigator, the employer and the employee, and is no more capable of being settled on a communistic than on a capitalistic basis. It can only be satisfactorily attacked when mutual distrust of motives, capacities, and methods is stilled.

INTERMETALLIC ACTIONS.

THE SYSTEM ALUMINIUM-ARSENIC.

By Q. A. Mansuri.

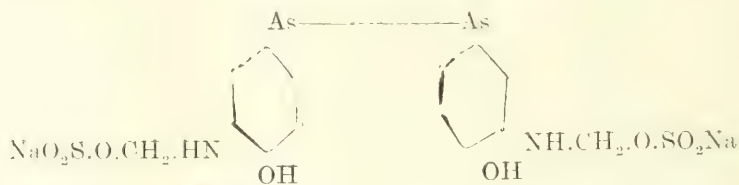
Although it has been stated that As combines with Al at high temperatures, little is known regarding the reaction. The present author finds that by heating a mixture of Al and As in a sealed tube at 800° and at low pressure, yellow arsenic is formed which reacts with the Aluminium

give a brown compound of the formula Al_3As_2 . This is stable at high temperatures, but is not so at low temperatures. Attempts to prepare another compound of a higher arsenic content were not successful. Al_3As_2 gives arsenic trihydride when exposed to moisture, and when heated in air is oxidised to Al_2O_3 and As_2O_3 . The formula established for this compound is of the type usually given to other metallic-arsenic compounds, viz., M_3As_2 .—(*J.C.S. Trans.*, p. 2277, 1922.)

SULPHARSPHENAMINE.

By C. VOEGTLIN AND J. M. JOHNSON.

This is the name given by the authors to the compound prepared from the hydrochloride of 3, 3'-diamino-4, 4' dihydroxy arsenobenzene, otherwise known as arsphenamine, formaldehyde and sodium bisulphite. It resembles neoarsphenamine in many respects. For its satisfactory preparation, arsphenamine is completely dissolved in a mixture of alcohol and water, and formaldehyde added, vigorously stirring during this addition. This gives a condensation product with the HCHO attached to both amino groups. Shortly after this addition, the formaldehyde-imide compound is treated with sodium bisulphite, giving rise to a sulphurous acid ester salt. The orange red solution is now poured in a thin stream into a large volume of alcohol, and the precipitated compound filtered off, washed with alcohol and dried. For successful work, care has to be taken as regards the time allowed for each stage of the reaction, and the rate at which the reacting substances are added. It is considered that this drug consists of an arseno-benzene derivative of the constitution:—



Experimental work has shown that the compound is suitable for subcutaneous injection in the case of protozoal diseases.—

(*Journal American Chemical Society.*)

ESTIMATION OF STARCH IN BARLEY AND WHEAT.

This problem has recently been the subject of investigation at the British School

of Malting and Brewing of the University of Birmingham, by Professor Arthur R. Ling, the work described being carried out under the Institute of Brewing Research

Scheme with the aid of a grant from the Institute's Committee. Professor Ling read a paper on the subject at a joint meeting of the Birmingham and Midland Section of the Society of Chemical Industry and the Midland Counties' Section of the Institute of Brewing, at the Birmingham University, on Thursday, November 23. Dr. Edward B. Maxted, of the former Society, presided over a very large attendance.

Starch, said the author, was the most widely disseminated reserve carbohydrate in the vegetable kingdom, and it had an economic importance possessed by few other vegetable products. In some form or other it entered into the dietary of man and animals to an extent exceeded perhaps by no other substance, whilst its many uses in the arts gave it a prominent position in several branches of chemical industry. It was remarkable, therefore—Professor H. E. Armstrong had said that it was little short of a disgrace—that up to the present, despite numerous attempts, no really satisfactory method of estimating starch had been devised. To the agriculturist, to the maltster, and to the brewer an accurate method of estimating starch was of the utmost importance, seeing that starch was the main constituent of all cereals. Professor Ling, after a review of the methods which had been proposed for estimating starch from the earliest times, concluded that C. O'Sullivan, in 1884, had approached the problem on sounder lines than any previous or subsequent investigator. Dr. Horace T. Brown and his co-workers in the celebrated Guinness researches, had found O'Sullivan's method to be on the score of accuracy the best which had been proposed. The length of time required for carrying out the method ruled out its application, however, for practical purposes. The Guinness workers had devised a rapid method of estimating starch, depending on the fact that when malt diastase acts on starch at 55-60 C., there is an apparent resting stage in the reaction. According to this, the percentage of maltose produced at the end of a given time (say 1 hour) bears a constant relation to the starch originally present. The actual percentage of maltose found in this way does vary, however, according to the diastatic power of the malt employed, and Professor Ling has now determined the relation of the maltose produced to the diastatic power of the malt employed. Barley and wheat starches were found to give identical results. Ground

barley or wheat is extracted for three hours with alcohol of specific gravity 0.920, which removes some of the proteins. It is then converted into a paste with hot water and treated with the extract of a malt of known diastatic power for an hour. The maltose is then estimated and the starch calculated by the formula: $S = 94.73 M'/M$, in which S is the percentage of starch in the sample, M is the percentage of apparent maltose produced from dry barley or wheat starch by the action of malt extract from malt of a definite diastatic power, and M' is the percentage of apparent maltose produced from the sample and with malt of the same diastatic power. The values 63.9 and 64.0 were obtained as the percentage of starch in the dry wheat. Some of the same wheat was then mixed with pure wheat starch of known moisture-content and the mixture analysed, employing a malt of diastatic power 67° (Lintner). The agreement was satisfactory, and Professor Ling takes the view that he and his collaborators are justified in the conclusion that the method gives satisfactory results. It was applied to cereals grown on the famous Broadbalk field at Rothamsted Agricultural Research Station, Offchurch. The method is to be adopted as a standard method. Professor Ling intends to extend his work to other starch-containing substances.

POTASSIUM AZIDO-DITHIO-CARBONATE.¹

By A. W. BROWNE AND A. B. HOEL.
(With Notes on Crystallography by A. C. Gill.)

[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY OF CORNELL UNIVERSITY.]

In connection with an investigation of the imide character of hydronitric acid, F. Sommer² succeeded in preparing and ana-

¹ The investigation upon which this article is based was supported by a grant from the Heckscher Foundation for the Advancement of Research, established by August Heckscher at Cornell University. The present paper is Article No. 3 under Heckscher Grant No. 4. For Articles 1 and 2 see *Jour. Amer. Chem. Soc.*, 1922, XLIV., 2136 and 2116.

² *Sommer, Ber.*, 1915, XLVIII., 1933-41.

lyzing the hydrated sodium and barium salts of a new acid, which he named azido-dithiocarbamic acid. These compounds were shown to have the formulae $\text{NaSCSN}_3 \cdot 4\text{H}_2\text{O}$ and $\text{Ba}(\text{SCSN}_3)_2 \cdot 5\text{H}_2\text{O}$. When the attempt was made by Sommer to prepare the corresponding potassium salt by a similar method, the crystalline product that he obtained exploded with violence as he spread it carefully, with the aid of a porcelain spatula, upon a porous plate, thus deterring him from further work upon this compound.

The formation of potassium azido-dithiocarbonate has been shown by the authors of the present paper³ to take place slowly, even at ordinary temperatures, when carbon disulphide is brought into contact with aqueous solutions of potassium trinitride. It has, moreover, been demonstrated that an important catalytic effect is exerted by this azido-salt in the reaction between aqueous solutions of potassium trinitride and iodine in presence of carbon disulphide. In this connection it has been found necessary to prepare and analyze the azido salt, and to study certain of its properties and reactions.

Method of Preparation.—A sample of pure potassium trinitride weighing 6 g. was dissolved in 25 cc. of distilled water, and the resulting solution, in a 100 cc. glass bottle, was treated with about 6 g. of pure, redistilled carbon disulphide, an amount slightly in excess of that required for the ratio $\text{KN}_3:\text{CS}_2$. The tightly corked bottle containing the reacting mixture was held at a temperature of about 40° in a water-bath, with occasional shaking, until the carbon disulphide had entirely disappeared.

A convenient test indicating the completion of this reaction consists in adding a few drops of iodine solution to a small sample of the reacting mixture. Immediate discharge of the iodine colour, unaccompanied by perceptible evolution of nitrogen, conclusively proves absence of unchanged potassium trinitride, as this substance would be quickly decomposed by the iodine, in presence of the azido salt, with quantitative liberation of nitrogen.

The solution of potassium azido-dithiocarbonate obtained by this method was concentrated over phosphorus pentoxide in a vacuum desiccator, almost to the point of saturation, and was then filtered carefully

to remove free sulphur. The clear filtrate was slowly cooled over ice until the formation of crystals took place. The crystals were cautiously removed, and were dried, first between filter paper, later on a porous plate, with the aid of a bone spatula, and finally in a vacuum over phosphorus pentoxide. Failure of the crystals, after thorough drying between filter paper, to lose appreciable weight when stored in a vacuum over phosphorus pentoxide for 60 hours, corroborated at the outset the opinion of Sommer that the potassium salt, unlike the salts of sodium and barium, ordinarily crystallises from aqueous solution in the anhydrous condition, a fact that has been verified repeatedly in subsequent work.

Analysis.—Carefully dried samples of potassium azido-dithiocarbonate prepared by the foregoing method were analysed as follows. The potassium was determined by heating weighed samples of the compound with sulphuric acid, and weighing the potassium sulphate formed.

Subs., 0.1677, 0.3381; K_2SO_4 , 0.0932, 0.1889. Calc. for KSCSN_3 : K, 24.86. Found: 24.94, 25.07.

The sulphur was determined by oxidizing weighed samples of the salt with conc. nitric acid and bromine, and weighing the sulphur in the form of barium sulphate.

Subs., 0.4502, 0.4669; BaSO_4 , 1.3550, 1.3942. Calc. for KSCSN_3 : S, 40.78. Found: 41.34, 41.01.

The nitrogen was determined by combustion of the azido salt with copper oxide in a current of pure carbon dioxide. The explosive character of the salt necessitated admixture with precipitated silica and with copper oxide in finely divided form. The mixture was distributed through the combustion tube over a length of about 25 cm.

Subs., 0.1343, 0.1629; N_2 , 28.53 cc. (0.03568 g.), 34.75 cc. (0.04346 g.). Calc. for KSCSN_3 : N, 26.73. Found: 26.57, 26.68.

Crystallographic Data.—Samples of the white crystals were submitted to Professor A. C. Gill, of the Department of Geology of Cornell University, who makes the following statement concerning their properties:

"The crystals examined presented quite variable habitus, though tabular development with 4-sided or 6-sided outlines was most common. The 6-sided crystals usually showed elongation parallel to the direction which may be designated in this description

³ Browne and Hoel, *Jour. Amer. Chem. Soc.*, XLIV., 2109 (1922).

as the macro-axis, though accurate determination of the crystallographic constant was rendered impossible, with the apparatus at hand, by the rather rapid deliquescence which the substance undergoes. The 4-sided crystals gave angles of very nearly 87° and 93° on the stage of a petrographic microscope. This would indicate an axial ratio of $a:b = 0.95:1$. Not even approximate measurements of the length of "c" axis were obtained. Reticulated masses very like the well-known occurrence of lead carbonate in nature were frequently observed under the microscope on evaporating the liquid in which the azido-salt had been formed on a warm glass slide. Five-sided crystals, bounded by the prism and one face of the macro-pinacoid, were rather frequently observed, but, on the whole, this was not thought to indicate a hemimorphic symmetry, as the parallel face was usually observable unless the development of the one face was rather small. The optical behaviour of the tabular crystals is the best argument for their rhombic character. They show parallel extinction in all positions, even in the reticulated masses. They are optically biaxial with a large angle, $2V$, greater than 75° . The axis of greatest elasticity bisects the acute angle of the prism, while the axis of least elasticity is normal to the tabular face (001). The optical character seems to be positive, though there is a possibility that the optical angle as seen in the ordinary position is greater than 90° , in which case the crystals are negative.

"Double refraction is rather strong, estimated at 0.050, and dispersion is very unusual. From the peculiar purple appearance of the first order red interference colour it would appear that the birefringence for red light is much stronger than for blue, so that a thickness of crystal producing 200 to 230μ retardation for the blue end of the spectrum produces something like twice that amount for the red end. Careful study of the substance by monochromatic light would be necessary to confirm the accuracy of this explanation."

Solubility.—Potassium azido-dithiocarbonate is very soluble in water, and deliquesces rapidly under ordinary atmospheric conditions. No accurate determination of the solubility was made, partly because of risk attending the use of relatively large amounts of this explosive substance. As a first approximation, however, small samples of the salt were weighed on watch

crystals. These were again weighed just as the last crystal was dissolving in the moisture condensed from the atmosphere. Samples weighing 0.0225 and 0.1720 g. were found to dissolve in 0.0049 and 0.0381 g. of water. One part of water will, therefore, dissolve about 4.5 parts of the azido-salt.

When brought into contact with various non-aqueous liquids, all strictly anhydrous, the azido salt was found to be fairly soluble in both methyl alcohol and acetone, very slightly soluble in ether, and practically insoluble in ethyl alcohol, benzene, carbon tetrachloride, carbon disulphide, and chloroform.

—From the *Journal of the American Chemical Society*, 1922, p. 2315-20.

(To be Continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

Papers read December 7th, 1922:—

LORD RAYLEIGH, F.R.S.: *Spectrum of Active Nitrogen as affected by Admixture of the Inert Gases.*

G. H. HENDERSON, PH.D.: *Changes in the Charge of an α Particle passing through Matter.* Communicated by Sir Ernest Rutherford, F.R.S.

W. T. ASTBURY: *The Crystalline Structure and Properties of Tartaric Acid.* Communicated by Sir William Bragg, F.R.S.

J. N. MUKHERJEE: *Sources of Error in the Measurement of the Electrical Charge of Colloidal Particles by the Method of Moving Boundaries. An improved Method based on a direct Measurement of the Potential Gradient across the Boundary.* Communicated by Prof. F. G. Donnan, F.R.S.

J. HEYROVSKÝ: *The Significance of the Electrode Potential.* Communicated by Prof. F. G. Donnan, F.R.S.

A. M. MOSHARRAFA: *On the Quantum Theory of the simple Zeeman Effect.* Communicated by Prof. O. W. Richardson, F.R.S.

S. BRODETSKY: *Discontinuous Fluid Motion past Circular and Elliptic Cylinders.* Communicated by Prof. G. H. Bryan, F.R.S.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, THURSDAY,
DECEMBER 7TH, 1922, AT 8 P.M.

The following papers were read:—

The isoelectric condition of gelatin: S. O. RAWLING and W. CLARK.

Studies on metal hydrides. The electrolytic formation of stibine in sulphuric acid and caustic soda solution: H. J. S. SAND, E. J. WEEKS, and S. W. WORRELL.

THE FARADAY SOCIETY.

At the Annual General Meeting held on November 20th, the following Officers and Council were elected to serve for the year 1922-1923:—

President, Sir Robert Robertson, K.B.E., F.R.S.

Past Presidents, Sir R. T. Glazebrook, K.C.B., F.R.S., Sir R. A. Hadfield, Bart., F.R.S., Professor A. W. Porter, F.R.S.

Vice-Presidents, Professor C. H. Desch, Professor F. G. Donnan, C.B.E., F.R.S., Dr. J. A. Harker, F.R.S., Professor T. M. Lowry, C.B.E., F.R.S., W. Murray Morrison, Professor J. R. Partington, Dr. G. Senter.

Treasurer, Robert L. Mond.

Council, W. R. Bousfield, K.C., F.R.S., Cosmo Johns, Dr. R. Lessing, Professor W. C. McC. Lewis, Professor J. W. McBain, Dr. H. Moore, C. C. Paterson, Dr. J. N. Pring, Professor A. O. Rankine, Dr. E. K. Rideal.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

At the meeting of the Society held on Wednesday, December 6th, at the Chemical Society's Rooms, Burlington House, Piccadilly, W., at 8 p.m., the following papers were read:—

A Note on the Estimation of Form- and Acet-aldehydes, by E. W. BLAIR, B.Sc., D.I.C., A.I.C., and T. SHIRLOCK WHEELER, B.Sc., A.R.C.Sc.I., A.I.C.

A Sliding Scale for the Convenient Titration of Strong Liquids by Dilution and Use

with Aliquot Parts, by C. H. DOUGLAS CLARK, B.Sc., D.I.C., A.I.C.

Note on the Presence of Sulphur Dioxide in Cattle Foodstuffs after Fumigation, by H. A. PEACOCK, B.Sc.

Some Observations with regard to the Unsaponifiable Matter and Sterols of Edible Fats, by D. W. STEUART, B.Sc.

Note on the Sulphuric Acid Test of Fish Liver Oils, by NORMAN EVERS, B.Sc., F.I.C., and H. J. FOSTER.

THE INSTITUTE OF METALS.

The Institute of Metals are admitting student memberships to be transferred to full ordinary memberships at the age of 25. The entrance fee is one guinea and the annual subscription one guinea.

Student members will be elected on Dec. 14th, and will have all the privileges of ordinary members except that of voting at meetings.

THE INSTITUTION OF RUBBER INDUSTRY.

"FUEL OIL."

By A. F. Baillie.

A meeting of the Manchester Section of the Institution of Rubber Industry was held at the Midland Hotel, Manchester, on Monday, November 20th. Mr. J. H. Mandleberg presided over a very large attendance of members.

The above-titled paper was read by Mr. A. F. Baillie, Chief Technical Engineer, Shell-Mex, Ltd., and dealt particularly with oil burning for raising steam in relation to the rubber industry.

Mr. Baillie said that fuel oil is used firstly at the wells for raising steam in connection with the drilling of the wells. It is also used at the refineries as a heating agent under the stills, and also as a fuel for steam-raising in various types of boilers. Fuel oil is further used in steamships for generating steam in their boilers for supplying the main engines. Again, fuel oil is used for steam-raising in numerous types of land boilers, also on locomotives and heating furnaces for metallurgical work.

In the consumption of fuel oil as a heating agent, it is first necessary to divide

finely or atomize the fluid, so that it can be mixed with the necessary quantity of air to make the resultant a combustible mixture. This process is called "atomization," and is effected by means of apparatus called "fuel-oil burners." These burners are manufactured by various engineering firms and come under three systems: (1) Air-jet System, (2) Steam-jet System, and (3) Pressure-jet System.

The first system used air under pressure as an atomizing agent. Low-pressure air is blown from a motor-driven fan, although for special classes of work, such as the manufacture of electrical bulbs and other white-glass ware, high-pressure air has in the past been used, and is supplied by blowers or compressors. For some particular classes of work it has been found to be an advantage to take all the air for atomizing and combustion through the burner, and in this case the air is intermingled with the oil in the burner, the proportion being 207 cubic feet of air per lb. of oil. Thus, due to all the air being under control, an oxidising or reducing flame can be obtained at will. For other classes of work the usual procedure is to take approximately 60 per cent. of air through the burners, and induce the necessary extra quantity of air from the atmosphere to complete combustion.

The second system, viz., the steam-jet system, uses steam under pressure as an atomizing agent. It is usual to take this steam from an auxiliary stop valve on the boiler or from a tee on the auxiliary steam line, and reduce the pressure of this steam from boiler pressure to 15 to 25 lbs. per square inch. The proportion of steam required for atomizing, say Mexican Fuel Oil, is approximately 3lbs. of steam per lb. of oil, or, on the other hand, say $1\frac{1}{2}$ to 2 per cent. of the total steam evaporated. Again, with the steam-jet type of burner, the requisite amount of air to complete combustion is induced from the atmosphere.

The third system, viz., the pressure-jet system, sprays the oil under pressure by means of a steam-driven pump, and also uses steam temperature to thin or reduce the viscosity of the oil. This latter system has been developed during the last 10 years to such an extent that it is recognised as the most economical system for burning oil under land and marine boilers. In this system oil is drawn from the storage tanks by means of a steam-driven pump through suction strainers and pumped through fuel-

oil heaters and discharge strainers to the fuel-oil burners. The object of the suction strainers is to collect any foreign matter in the oil so as to protect the suction and discharge valves of the pump. The object of the heaters is to raise the temperature of the oil to such a degree that the oil, when intermingled with sufficient quantities of air, is suitable for combustion. The object of the discharge strainers is that, after the oil is passed through the heaters, a certain amount of foreign matter is released and is then trapped by these strainers so as not to choke the nozzles of the burners, as these nozzles are very fine, ranging from 1 to 2.5 mm. The hot oil under pressure issues from the burner in the form of a fine whirling mist. The necessary air for combustion is introduced through special furnace fronts, which slightly pre-heat the air and impart to it a rotary motion in the opposite direction to the burner spray, in order thoroughly to intermingle and mix the oil spray and air supply, and so give complete combustion in the furnace. The quantity of air for combustion is under absolute control by means of dampers or air controls, fitted to the furnace front. These air controls can be fitted when using either natural or forced draught.

These three types of burners have their various uses, the steam-jet being used generally for small land boiler plants, the pressure-jet system for large boiler plant and marine purposes, and the air-jet system for furnace heating and metallurgical work.

For comparative purposes, and assuming each of these systems tested under a steam boiler, there would be obtained a thermal efficiency of approximately 78 per cent. for the steam-jet system, 80 per cent. for the air-jet system, and 85 per cent. for the pressure-jet system.

CORRESPONDENCE.

CARBON SUBOXIDE.

TO THE EDITOR OF "THE CHEMICAL NEWS."

SIR,—I notice, according to a paper recently published in the *Berichte*, that Messrs. Ott and Schmidt have devised a method whereby Carbon Suboxide can be prepared in a higher degree of purity and in much larger quantities than heretofore. It is to be hoped that the vexed question of the constitution of this substance will now be definitely settled. In this connection I

should like to call attention to a paper of my own, published in Vol. 120 of *The Chemical News* (pp. 209 and 210), in which I point out that the heat of combustion of this substance would provide a perfectly satisfactory criterion for deciding between the two alternative constitutional formulæ. Unfortunately, I lack the facilities for carrying out the necessary experiments and determining the heat of combustion of the substance myself, but I trust that this will now be done by some investigator more fortunately circumstanced than myself.

I am., Yours, etc.,

H. STANLEY REDGROVE.

191, Camden Road, London, N.W.1.

NOTICES OF BOOKS.

The Theories of Organic Chemistry, by DR. F. HENRICH, translated and enlarged from the fourth German edition of 1921 by TREAT B. JOHNSON and DOROTHY A. HAHN, PH.D. Pp. XVI. + 603. London: Chapman & Hall, Ltd. 1922. Price 30s.

Thanks to the laborious and praiseworthy efforts of the American translators, Prof. Henrich's volume has now become more accessible and available for English speaking chemists.

The literature of organic chemistry is so extensive and hypotheses undergo constant change and revision, or are entirely cast aside as new developments and discoveries are made, that the authors have necessarily been unable to give a complete review of the whole subject. They have, however, presented a valuable record of the progress and the theoretical deductions therefrom in the field of organic chemistry.

In the portions on the history of Structural Chemistry, the ideas of Frankland, Kolbe, and later, those of Kekulé, Van't Hoff, von Bayer, and Thiele are carefully developed.

Recent speculations relating to the Electronic Conception of Valency have been quoted at some length. Such subjects as the Relation between Colour and Constitution and the Theory of Indicators have naturally received attention. The concluding chapter deals with recent and important Electrochemical Theories.

It is evident that in some parts, for the sake of clearness, the matter has been rewritten rather than merely translated. Several new chapters have also been introduced, and other additions have been made to include the results of recent researches, especially those by Americans.

Prof. Henrich has written a preface to this edition, approving of these alterations and additions which the translators have made.

This work forms, therefore, a useful source of information for advanced students and those engaged in teaching Chemistry.

J.G.F.D.



This list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 30632—Carmichael & Co., Ltd.—Apparatus for manufacture of sulphuric acid. Nov. 9.
- 30593—Chemische Fabrik Greisheim-Elektron.—Production of stable compounds of calcium hypochlorite. Nov. 8.
- 30772—Coley, H. E.—Reduction of ores, oxides, etc. Nov. 10.
- 30932—Imray, O. Y.—Manufacture of azo-dye-stuffs, and chromium compounds thereof. Nov. 10.
- 30301—Lijunden, L. L. J.—Process of obtaining metals from their chloride vapours. Nov. 6.
- 30300—Lijunden, L. L. J.—Chloridizing volatilization of metals. Nov. 6.
- 30837—Lindsay, W. B.—Elimination of sulphur from oil. Nov. 10.

Specifications Published this Week.

- 187636—Potter, C. K.—Manufacture of chromium compounds.
- 174370—Rhenania Verien Chemische Fabriken Akt-Ges.—Process for rendering soluble crude phosphate.
- 165752—Rheinisch-Nassauische Berwerke & Hutten Akt-Ges.—Method of producing chemically-pure hydrochloric acid.
- 181313—Manufacturers De Produits Chimiques Du Nord Etablissements Kuhlmann.—Mechanically-operated furnaces for roasting pyrites.

Abstract Published this Week.

Chlorinating Methane.—Patent No. 186270.—A new process for the chlorination of methane has recently been patented in this country by Messrs. Holzverklung Industrie, Akt-Ges., of Konstanz, Baden, Germany.

Steam is employed as a diluent to the reacting gases to moderate the violence of the reaction, and at the same time to supply, if necessary, the heat for its initiation. In general 2.5 volumes of heat for its initiation. In general 2.5 volumes of steam per unit volume of chlorine are used, and temperatures above 650° C. are avoided owing to temperature above 650° C. are avoided owing to the decomposition of steam and formation of oxides of carbon. Catalysts such as chlorides of copper, iron, and the alkaline earth metals may be employed, with or without porous carries. The relative proportions of the reacting gases are dependent on the dimensions of the reaction tubes and upon the products required. Examples are given in which the methylene dichloride chloroform, and of carbon tetrachloride is promoted.

Messrs. Rayner & Co. will obtain printed copies of the published Specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3270

ORDINARY GENERAL MEETING OF
THE INSTITUTE OF MINING AND
METALLURGY, THURSDAY,
OCT. 19, 1922.THE 'DAVON' MICRO-TELESCOPE
AND SUPER-MICROSCOPE.

By F. DAVIDSON.

Mr. Davidson said that the apparatus which he had the pleasure of introducing marked a step in progress towards utilising the microscope in a variety of ways which had hitherto been rather unassociated with it. There was nothing really revolutionary about it, although they brought the telescope, as it were, almost into microscopic uses and the microscope somewhat into telescopic uses. The two instruments, of course, had each their special field of utility, the telescope dealing with distant objects and the microscope with near objects, but by certain additions to the microscope the gap between the two instruments was bridged. That, he thought, he would be able to demonstrate to the members.

The principle involved in the apparatus, to take the micro-telescope first, was the application of a short-focus telescope-objective in a tube with a series of diaphragms to the microscope, the microscope itself acting as a compound eye-piece. With that attachment, which contained a 6-in. telescope-objective inserted into the 'Abbé' rim of the microscope, there was an image of a distant object projected to the plane of the stage and that air image was magnified by the microscope proper, and, as a result, objects could be seen as near as 6 ft. Its range was practically from 6 ft. to infinity. One could then, for example, view the scales of barometers or thermometers at any distance, inaccessible parts of the machinery and certain parts of a mine, provided, of course, that the light could be projected on to the object. Rock *in situ* could be examined. Distance practically did not affect it. But above all, the chief characteristic of the observations one got was depth of focus. One could look at an ordinary photograph with that instrument and see it in apparent stereoscopic relief. That was rather a large statement to make,

but members would believe the evidence of their own eyes.

The idea of employing a telescope-objective on a microscope was not a new one. He remembered when he first introduced it, quite a controversy raged in the pages of a certain journal, and one gentleman said he had tried it forty years previously, but it was no good. His reply was that because Tom did not succeed it was no reason why Harry should not. The fact remained that they had a micro-telescope which was capable of being used in a variety of ways and for a variety of purposes for which the orthodox telescope could not be used. Members would have an opportunity—perhaps some had already had it—of looking through the telescope at a bird's nest which was photographed with the micro-telescope, by a doctor in Ireland, at a distance of 50 yards.

Next, they had an attachment of shorter focus with which they did some rather remarkable work in regard to objects which, because of their size or shape, could not be put upon the stage of a microscope—minerals, especially metal fractures, and material of various kinds on which there were various planes which could not be brought into focus with an ordinary microscope. The observation of a piece of coral and a transverse fracture of aluminium alloy would be seen, and those who would look through the instrument would be struck with the extraordinary depth of focus thus obtained. A variation of magnification of from 30 diams. to 90 diams. was possible without altering anything but the distance from the object. Even at the higher magnification the relative depth of focus was always maintained. He could not, of course, state all the uses to which such an instrument could be applied, but no doubt there were directions in which its application would be at once apparent to most of the members. But, as far as they had been able to utilise it themselves, it had been agreed by men connected with various industries that it opened up a new field of observation.

Then, coming to the third attachment, when it was put on to the microscope it carried the system of direct observation very much further. There was another tube in which they placed a microscope-objective at one end. At the other end of the tube was another achromatic combination which he called a collector, and then they had what he called the super-micro-

scope. The word 'super' was perhaps not wisely chosen. To him it was a curtailment of the word 'superior,' but many had thought that it meant nothing else but super-magnification. Well, it did not mean anything of the kind. However, that was what he called it—the super-microscope. By means of the collector the image of a *microscopic* object was projected at some distance beyond it. The position of the air image which was projected depended upon the distance that the collector happened to be from the front or primary objective. That enabled them to carry that system of direct observation which was begun with the short-focus attachment up to pretty nearly 1,000 diams. and still have sufficient working distance to illuminate an object from above.

He remembered once giving a demonstration at Leeds University, and mentioning that, and one of the professors brought a scale from his pocket of $\frac{1}{100}$ mm., and requested him to show that under such conditions. The professor was very agreeably surprised when he showed him that, under a magnification of 1,000 diams., every line on the scale stood up like a fence, and he immediately said that it opened up possibilities. As they would be aware, the working distance under high magnification of the ordinary microscope was a very small one. One could, with that system, for that particular class of work go to very nearly 1,000 diams. and have a $\frac{1}{4}$ -in. working distance.

He did not want them to believe that he meant that they could examine critically etched-metal specimens or anything of that kind. He had been called over the coals for venturing the remark that there were two kinds of microscopy, critical and non-critical. It had been said, "We only recognise one kind of microscopy, which is *critical* microscopy," to which he replied that examination microscopically under comparatively low power of a piece of metal or a piece of mineral could not be in the same class of observation as looking under a magnification of 1,000 or more at an etched-metal specimen where the *structure* was required to be observed. But he thought for certain classes of observation the facility of being able to make observations under a fairly high magnification with sufficient distance to illuminate the object from above certainly opened up some possibilities; in fact he knew it did in certain directions.

When they came to critical work the structure of the super-microscope was altered. For a long time they could not find anyone who would even look at the super-microscope. They were so convinced that it was all wrong of course it was horribly unorthodox, he knew—that nobody would look at it. He was speaking now of the bacteriological side of it just for the purpose of explaining the position. The position that he took was that, unorthodox as it was, the super-microscope was still capable of performing critical work, in addition to the many other uses to which it could be applied. For example, with a 4-in. objective as the primary, and a 1-in. as the secondary, one could obtain a variation of magnification of from 80 diams. to 180 diams., and have a working distance of 5 in. at the lower magnification and 2 in. at the higher, with all the attendant advantages of field and depth of focus. It remained for a doctor eventually to approach the subject with an unbiassed mind, and to find out whether he was right or wrong. After prolonged experiment the doctor came to the conclusion that if the whole of the super-microscope arrangement was placed above the stage of the microscope and not, as it was before then, partially below it, then a one-sixth objective would do all that a one-twelfth would do except for the very highest critical research work.

The doctor made very severe tests upon the granules of leucocytes, and he was able to say that he could go to a magnification of about 1,300 with a one-sixth objective before resolution began to fail. That was a very high magnification to put on a one-sixth objective. It really went against all accepted laws or rules upon the subject, but the fact remained that it could be done.

When that point had been decided, they built the super-microscope as they had it before then, in which the whole of the structure was above the stage. The collector was above the microscope O.G., and then there came the microscope proper. The magnification was varied by altering the distance between the microscope-objective and the collector. There was the usual fine focussing of the microscope, and also the means for moving the eye-piece and objective of the secondary microscope in order to focus the air image. As a result of that, they were able to say definitely, that although they had interfered with the principles upon which the microscope was constructed, and the principles upon which the

objective was constructed, the results remained good.

A criticism which had been made was that one dared not interfere with the tube length for which a microscope objective was constructed, and the fact that they did interfere with it or ignored the question of tube length would be fatal. But the fact remained that it was not fatal. A critical image could be obtained with the super-microscope just as well as with an orthodox microscope. However, the broad claims which were made for the apparatus, generally speaking, were that the gap between the microscope and the telescope was bridged, and that with the super-microscope they appeared to be able to utilise a higher magnification than was usually employed upon an objective without losing the resolution. He did not wish it to be thought that he was claiming to give higher resolution by means of that higher magnification. Neither he nor anybody else could give a higher resolving power than the primary microscope-objective was capable of giving, but without losing that resolving power they did appear to be able to utilise a higher magnification upon that objective.

The other point he would like to bring to their notice was the fact that anything that could be seen with either piece of apparatus could be photographed by it by simply removing the body tube of the microscope and substituting a camera. They had photographed all sorts of things at all sorts of distances, and he would have the pleasure of showing some of them upon the screen directly. But let them take this, for example; they were able to use the same lens for tele-photography as for observation, and some very remarkable tele-photographs had been taken. With a short attachment they had photographed metal fractures and things like that, and with the super-microscope they had photographed things from life-size to diatoms under a magnification of 3,000 diams.

HISTORY OF SOAP.

BRISTOL'S SHARE IN GREAT INDUSTRY.

Lecture by Mr. E. Lewis, F.I.C.

A meeting of the Co-Partners' Club of Messrs. C. Thomas and Bros., Ltd., soap manufacturers, Bristol, was held at Broad Plain Hall, Bristol, last week, when Mr.

F. A. Glass presided over a very large attendance of members and friends.

An illustrated lecture on "Soap and Glycerine Manufacture" was given by Mr. E. Lewis, F.I.C., chemist to Messrs. C. Thomas and Bros., Broad Plain, and dealt particularly with the early history of soap making, referring to the antiquity of the industry in Bristol, modern methods of seed crushing for oils used in the soap industry, together with the modern methods of soap manufacture and the recovery of glycerine as a product. Mr. Lewis said that in its broadest sense soap is a compound of a fat, or, more correctly, a fatty acid with a base, and is produced by the action of alkalies, such as soda or potash on tallow, coconut oil, or olive oil. Other soaps are known, such as that of ammonia used in dry cleaning, that of lead used in pharmacy, and zinc soaps used in the oil and paint industry. Commercially it is customary to restrict the term soap to soda, potash, and ammonia soaps. Dealing with the early history of soap, it was stated that no record exists of its discovery, but it appears to have been an ancient art, and in a large measure an ordinary household process, the product being a mixture of goat's tallow and the liquor obtained on leaching wood ashes. The lecturer stated that a large use had been made, and is still used in isolated areas, of natural products as detergent agents. The Romans used Fuller's earth to a considerable extent, as it possesses the property of absorbing grease when stamped into cloth and removed by subsequent scouring. Even up to the beginning of the 18th century this system was practised in Rome.

EARLY SOAPS.

Soap is first mentioned in 630 B.C., but this appears to be a reference to detergents, such as the roots of various plants which possess the property of forming a lather when rubbed on the wet skin or clothes. Jewish history records the use of a certain herb called "borith," which word is translated soap in the English version of the Bible. The Indians of Mexico and certain portions of California use even to-day the roots of the Amole plant and seeds of the Sapindus tree (soap berries) for cleansing purposes. In tropical countries the fruit and bruised leaves of the soap wort plant are used, which contains the chemical Saponine; this is contained to a small extent in the English horse chestnut.

In Chili, the inner bark of the Quillac tree, after reducing to powder, is used as a substitute for soap. In the first century mention is made of soap by Pliny, and Geber in the second century refers to the use by physicians of lead soaps as an ingredient of plasters. During the excavations at Pompeii the remains of what was apparently a soap-making establishment has been discovered. The Germans were acquainted with a crude method of soap manufacture in the 7th century, the Italians in the 8th, and the 10th century saw its manufacture established on a commercial scale at Marseilles, a city which became celebrated for the quality of its product. This city was favourably located, since it was in the centre of the olive oil producing region, and the sea coast furnished the seaweed from which the alkali was made. In England up to the 14th century there were no regular establishments devoted entirely to soap manufacture; the greater portion was made in a crude way domestically, and used principally for fulling cloth.

THE INDUSTRY IN BRISTOL.

In 1624 Charles I. formed a monopoly of the industry to a Corporation of London soap-makers. A few years later Bristol, in consideration of a heavy payment, was allowed to make 600 tons a year, a small quantity in comparison with the then normal output. The 18th century files of the Bristol newspapers contain advertisements by the Bristol Soapmakers offering rewards for information of attempts to break the soap monopoly. Soap making appears to be a very old Bristol trade; it is mentioned by Richard of Devizes, who lived towards the end of the 12th century. In the Middle Ages large quantities of Bristol soap were sold in London. In 1523, says a local authority, Bristol supplied London with the best grey speckled soap, or ye grey mottle. The trade was certainly in a flourishing state at the end of the 16th century, as we owe one of our finest schools to the prosperity of the trade at that time. It is well-known that the Queen Elizabeth School, better known as the City School, was founded by John Carr, a soap-maker, who bequeathed a house and 50 acres of land in the parish of Siston, 15 acres of land at Stowick, in the parish of Henbury, and a house in Host Street, Bristol. In 1711 an Excise duty of 3d. a lb. was imposed on all soap made, a tax which was not repealed until 1853, when the soap manufactured in this country amounted to

100,000 tons. Last year the soap produced in this country is estimated at 300,000 tons.

Mr. Lewis showed some excellent lantern slides of primitive and modern methods of seed crushing for soap oils and fats, modern methods of soap manufacture, glycerine evaporation and recovery plants, the whole being well illustrated by line drawing lantern sketches. The chemical operations were illustrated by some ingeniously devised diagrams, which showed much originality and ingenuity. The lecture concluded with a number of experiments conducted before the lantern, showing the varying thickness of the walls of a soap bubble, and the tension of soap films in various geometrical figures and spirals, in the form of wire frames. A well-arranged exhibit of soap-making materials was shown during an interval, the whole being arranged in sequence, from the stage of the nuts in their native state to that of the finished soap and glycerine.

The lecturer expressed thanks to Mr. Walls and Mr. Fraser, directors of the company, for providing the slides and granting every facility in the preparation of the lecture and exhibits.

CYPRINE AND ASSOCIATED MINERALS FROM THE ZINC MINE AT FRANKLIN, N.J.

By J. VOLNEY LEWIS AND LAWSON H. BAUER.*

The following notes refer chiefly to cyprine, the sky-blue variety of vesuvianite, in intimate microscopic mixture with willemitite, and to the associated rhodonite (var. bustamite) and andradite (var. polyadelphite).

1. *Vesuvianite, var. Cyprine*. — Bluish green fibrous cyprine was found in granite in the Parker shaft, at Franklin, in 1905, and was described by Professor Palache,¹ who also published the analysis by Steiger, which is quoted below for comparison.

The mineral here described was found in the ore body near the hanging wall in a crosscut 374.5 feet south and 361.5 feet west of the Parker shaft, and 10 feet above

* *The American Journal of Science*, September, 1922.

¹ Charles Palache: *Contributions to the Mineralogy of Franklin Furnace, Amer. Jour. of Science*, 1910, (4), XXIX., 184.

the 80-5foot level. It is sky-blue in colour; in texture it varies from fine granular and fibrous to dense. To the naked eye, and even under the hand lens, it appears to be homogeneous. The analysis (A, below) showed nearly 22 per cent. zinc oxide, and since the oxide ratios fell within the limits of variation of vesuvianite, it was supposed that a new variety of this mineral had been found.

Thin sections showed, however, that while vesuvianite is the dominant mineral, it is plentifully sprinkled with rounded grains and hexagonal crystals of willemite, with dimensions up to 0.16 mm. in diameter. Measurements by the Rosiwal method showed that this mineral constitutes 29 per cent. of the volume, or 33.3 per cent. of the mass. If the zinc, iron, and manganese of the accompanying analysis (A) are assigned to willemite, the calculation gives 32.68 per cent. of this mineral. The remaining constituents, calculated to 100 per cent., represent approximately the composition of the vesuvianite. A few minute particles of metallic copper were visible under the microscope, but doubtless most of the copper determined is in combination.

The analysis of this mixture and the results of the calculations are given here, together with Steiger's analysis² of cyprine from the Parker shaft.

Analyses of vesuvianite from Franklin, New Jersey.

	(A)	(B)	(C)	(D)
SiO ₂	32.42	8.70	35.14	36.41
Al ₂ O ₃	14.07		20.86	17.35
FeO	0.77	0.77		1.86
MnO	1.50	1.50		1.75
ZnO	21.71	21.71		1.74
CuO	0.99		1.47	1.48
CaO	25.22		37.40	33.21
MgO	1.08		1.60	1.38
H ₂ O	2.38		3.53	(-0.24)

Others

100.14 32.68 100.00 100.08

A.—Vesuvianite-willemite mixture, apparently homogeneous. L. H. Bauer, analyst.

² U.S. Geol. Survey, Bulletin, 1915, MXCI., 315. This statement of Steiger's analysis, which is followed here, differs slightly from that given by Professor Palache.

B.—Willemite calculated from A.

C.—Remainder of A, recalculated to 100 per cent.—approximately the composition of the vesuvianite.

D.—Steiger's analysis of vesuvianite from the Parker shaft. Sp. gr. 3.451, care-Analyses of bustamite from Franklin, N.J., and Langban, Sweden.

fully freed from specks of metallic copper.

2. *Rhodonite, var. Bustamite.*—Pale pink in colour; elongated cleavable to coarsely fibrous in texture. Calcium replaces manganese to a remarkable degree, as shown by the analysis (E), by L. H. Bauer, with which is compared (F) the mineral from Langban, Sweden, as given by Dana (System of Mineralogy, p. 380):

	(E)	(F)
SiO ₂	46.72	47.96
Al ₂ O ₃	1.34	
FeO	0.46	0.48
MnO	26.51	31.65
ZnO	1.34	
CaO	22.24	18.16
MgO	1.27	1.18
Others		0.98

99.88 100.11

3. *Andradite, var. Polyadelphite.*—The brown granular garnet associated with the vesuvianite approaches typical andradite in composition (analysis G, by L. H. Bauer) more nearly than the specimens from Franklin represented by the older analyses, (H) and (I), quoted by Dana:

Analyses of Andradite from Franklin, N.J.

	(G)	(H)	(I)
SiO ₂	34.28	34.83	33.72
Al ₂ O ₃	3.12	1.12	7.97
Fe ₂ O ₃	25.53	28.73	17.64
MnO	7.41	8.82	16.70
CaO	29.20	24.05	25.88
MgO	0.39	1.42	(Ign. 0.08)

99.93 98.97 101.99

Besides the minerals named above, brown and reddish brown phlogopite is also abundant in scales and crystals, and in places coarse cleavable feldspars. Some of the latter give extinction angles corresponding to labradorite and others to anorthite. There are also very rare grains of pyrite, a small amount of cleavable calcite, and a little dark green pyroxene.

October 26, 1921.

a PbO tr.; Na₂O 0.44; K₂O 0.50; F 0.36; less O = F 0.15.

b BaO 0.19; alkalis 0.27; gangue 0.52.

POTASSIUM AZIDO-DITHIO-CARBONATE.¹

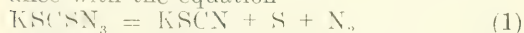
By A. W. BROWNE AND A. B. HOEL.
(With Notes on Crystallography by A. C. Gill.)

[CONTRIBUTION FROM THE DEPARTMENT OF
CHEMISTRY OF CORNELL UNIVERSITY.]

(Continued from Page 349.)

Decomposition.—The azido salt is rather sensitive to shock. Dry crystals have repeatedly been broken in an agate mortar, but during this operation several samples have exploded with violence. The explosion experienced by Sommer on rubbing the moist crystals upon a porous plate was undoubtedly due to the sensitising action of the sharp edges of the plate.

When heated slowly in a capillary melting-point tube, the crystals began to decompose at about 126°, with evolution of gas. When heated rapidly upon an iron plate, the substance detonates with a sharp explosion, but less violently than do the heavy metal trinitrides. Slow thermal decomposition of potassium azido-dithiocarbonate takes place quantitatively in accordance with the equation



Samples of the azido salt weighing 0.1296 and 0.1405 g. held at 100° for about 50 hours in a nitrometer tube yielded 17.64 and 19.01 cc. (corr.) of nitrogen, corresponding to 1.91 and 1.90 atoms of nitrogen per molecule of the salt. Titration of the aqueous extract of each residue with standard silver nitrate solution showed the pre-

sence of 0.0793 and 0.0869 g. of potassium thiocyanate, or 0.99 and 1.00 molecule of this substance per molecule of azido salt.⁴

The final residues obtained after the extraction consisted of 0.0237 and 0.0245 g. of free sulphur, corresponding to 0.90 and 0.86 atoms of sulphur per molecule of the salt. The low values for sulphur are attributable to unavoidable loss of small amounts of that substance by sublimation during the long period of heating in the nitrometer.

When the azido-salt explodes in the open air a spectacular flame is produced, with liberation of much heat and formation of numerous products. Samples of the compound weighing 0.2 g. and held in a deflagrating spoon suspended in the centre of a 12-litre Pyrex glass flask were detonated by means of an electric spark. The presence of sulphur dioxide, carbon dioxide, hydrogen sulphide, sulphur trioxide, free sulphur, and potassium thiocyanate as products of the decomposition in addition to nitrogen was established. The principal reaction may therefore be expressed by the equation, $2\text{KSCSN}_3 + 5\text{O}_2 = \text{K}_2\text{S} + 3\text{SO}_2 + 2\text{CO}_2 + 3\text{N}_2$ (2) although a part of the sample undoubtedly decomposes in accordance with Equation 1.

Aqueous solutions of the azido salt are quite stable at temperatures of 10° or lower, as is also the dry salt itself. At somewhat higher temperatures, however, the aqueous solutions gradually become turbid, with separation of sulphur, liberation of nitrogen, and formation of potassium thiocyanate. A solution obtained by dissolving 0.1870 g. of the salt in 10 cc. of water, and held in a Lunge nitrometer at 20-25° gradually became turbid, and liberated in 16 days 2.44 cc. (corr.) of nitrogen. Samples of the dry salt stored in the desiccator at room temperatures gradually turn yellow, owing to the separation of sulphur.

When a solution of the azido-salt was subjected to distillation thiocyanates were obtained in the residue, but no appreciable quantities of cyanides, sulphides, sulphites, carbonates, trinitrides, or of ammonia were found in either distillate or residue. When 15 cc. of an approximately 20 per cent. solution of the azido salt was mixed with an equal volume of 6 N potassium hydroxide solution, and distilled until half of the volume had gone over, thiocyanates were found in the residue. With 6 N sulphuric acid in place of the alkali, both thiocyan-

¹ The investigation upon which this article is based was supported by a grant from the Heckscher Foundation for the Advancement of Research, established by August Heckscher at Cornell University. The present paper is Article No. 3 under Heckscher Grant No. 4. For Articles 1 and 2 see *Jour. Amer. Chem. Soc.*, 1922, XLIV., 2106 and 2116.

⁴ In connection with certain of the earlier experiments the presence of potassium thiocyanate among the products of decomposition of the azido salt was established by microchemical tests performed by Professor E. M. Chamot, of whose work the authors desire to express their appreciation.

ates and sulphides were found in residue and distillate. In a blank experiment with potassium thiocyanate and sulphuric acid similar results were obtained. In no case were cyanides, sulphites, carbonates, trinitrides, or ammonia detected.⁵

Small amounts of a solution of potassium azido-dithiocarbonate were added to aqueous solutions of silver, mercurous, mercuric, bismuth, cupric, cadmium, aluminium, chromium, nickel and cobaltous nitrates; ferrous, ceric, zinc, and thallous sulphates; stannous, and manganous chlorides; lead, and cupric acetates, and qualitative observations were made which, in the main, corroborate the work done by Sommer with a solution of the sodium salt, in investigating the properties of the azido-dithiocarbonate ion.

Solutions of potassium azido-dithiocarbonate, when treated with certain oxidizing agents yield a white precipitate of azido-carbondisulphide, $(SCSN_3)_2$. It was found by Sommer that solutions of (a) iodine in potassium iodide, (b) ferric chloride, (c) potassium permanganate, potassium dichromate, and ceric salts in presence of sulphuric acid, behave in this manner. These results have been confirmed by the authors,⁶ and additional oxidizing agents, including potassium persulphate, hydrogen peroxide, bromine water, chlorine water, as well as sodium nitrite, manganese dioxide in sulphuric acid solution, and stannic chloride in hydrochloric acid solution, have been found to react at room temperature with solutions of the azido salt, precipitating azido-carbondisulphide. Potassium iodate reacts slowly, after standing for several hours, while ozone yields no precipitate whatever. Anodic oxidation of the azido salt in aqueous solution readily yields azido-carbondisulphide.

Structure. — The fact that potassium azido-dithiocarbonate decomposes quantitatively when gently heated, into potassium thiocyanate, sulphur, and nitrogen affords almost conclusive proof of the correctness of the structure assigned by Sommer to salts of azido-dithiocarbonic acid. If the correctness of the Angeli-Thiele-Turrentine formula for hydronitric acid be assumed,

the structure of potassium azido-dithiocarbonate is as follows: $K-S-C(=S)-N \equiv N$.

SUMMARY.

1. Potassium azido-dithiocarbonate, found by analysis to have the formula $KSCSN_3$, may be prepared by the action of carbon disulphide upon potassium trinitride in aqueous solution.

2. The colourless, unstable, deliquescent crystals of this azido salt decompose quantitatively when gently heated, yielding potassium thiocyanate, sulphur and nitrogen, or explode when rapidly heated, with formation of potassium sulphide, carbon dioxide, sulphur dioxide and trioxide in addition to these products.

3. Solutions of the azido salt when treated with various oxidizing agents, or when subjected to electrolysis, yield azido-carbondisulphide, $(SCSN_3)_2$.

ITHACA, NEW YORK.

—From the *Journal of the American Chemical Society*, Sept., 1922.

PROCEEDINGS OF SOCIETIES.

THE ROYAL SOCIETY.

ORDINARY MEETING, NOVEMBER 23, 1922.

*Sir Charles Sherrington, President,
in the Chair.*

The following papers were read, the summaries here printed having been supplied by the authors for use at the meeting:

DR. T. E. STANTON, F.R.S.: *On the Characteristics of Cylindrical Journal Lubrication at High Values of the Eccentricity.*

The paper describes the results of experiments on cylindrical journal lubrication, in which the arc of contact of the film is limited in extent and the intensity of pressure is considerably higher than in normal practice. The extent of the arcs of contact has varied from 14 to 35 degrees and the maximum intensities of pressure from 1.4 to 3.5 tons per sq. inch. In all the cases observed it has been found that the pressure distribution in the film has been in accordance with the hydrodynamical theory laid down by Osborne Reynolds.

By means of a careful determination of the pressure distribution in the film, and a measurement of the radius difference of bearing and journal, sufficient data have been obtained to calculate the viscosity of

⁵ These and certain other qualitative tests, connected with the present investigation, were performed by Miss Hazel E. Braman, to whom the authors wish hereby to express their gratitude.

⁶ In connection with this work the authors acknowledge with pleasure the assistance rendered by Mr. A. L. Satterthwaite.

the lubricant and the attitude and eccentricity of the bearing without the necessity of an integration of the hydrodynamical equations of motion.

The values of the viscosity of the lubricant so calculated were found to be in good agreement with those independently determined in a viscometer, and it was concluded that the calculated values of the eccentricity were reliable. In the case of a journal 2.5 cms. diameter, the least distance apart of the surfaces was found to vary from 0.0012 to 0.0024 mm.

J. H. JEANS, SEC. R.S.: *The Propagation of Earthquake Waves.*

The free vibrations of a non-homogeneous gravitating earth are investigated, and earthquake waves are regarded as being compounded of a number of such free vibrations.

In 1885 Lord Rayleigh discussed a certain type of surface waves which would travel over the earth's surface with a velocity of about $0.92 \sqrt{(\mu/\rho)}$. It is now shown that there are additional, and far more numerous, surface waves which travel with velocities $\sqrt{(\mu/\rho)}$ and $\sqrt{((\lambda+2\mu)/\rho)}$. If such waves are generated by an earthquake at any point close to the earth's surface, they will refocus themselves upon this point after intervals which are integral multiples of $2\pi a \sqrt{(\rho/\mu)}$ and $2\pi a \sqrt{(\rho/(\lambda+2\mu))}$, the numerical values of these quantities being about 223 and 126 minutes respectively.

In 1917, two series of earthquakes, each originating from the same centre, had their times given approximately by formulæ of the type—

$$t = t_0 + n_1 \times 125.8 + n_2 \times 222.0 \text{ minutes.}$$

The question is raised whether it is possible that the return waves sent out by one shock may produce a second shock by a kind of "trigger" action.

PROF. F. A. LINDEMANN, F.R.S., and G. M. B. DOBSON: *A Theory of Meteors and the Density and Temperature of the Outer Atmosphere to which it leads.*

Formulæ are derived for the head-resistance and heating of a particle moving through the air at a speed great compared to that of sound.

It is shown that all major meteoric phenomena can be accounted for consistently if the luminosity of the meteor is attributed to the collision of volatilised meteoric vapour with the air molecules.

From observed meteoric data the density of temperature of the air at great heights

is derived in four independent ways which give results consistent with each other.

The density above 60 km. appears to be very much greater than corresponds to an isothermal atmosphere at 220° Abs., and the temperature appears to be in the neighbourhood of 300° Abs. A tentative explanation is put forward to account for such a high temperature based on the radiative properties of ozone.

PROF. F. C. THOMPSON and E. WHITEHEAD: *On the Changes in Iron and Steel at Temperatures below 280° C.* Communicated by Prof. H. C. H. Carpenter, F.R.S.

1. Iron shows abnormalities of rate of increase of electrical resistance and electric potential against platinum at well-marked temperatures. Below 280° C. these temperatures are: 55, 100, 120, 140, 220 and 245° . Of these those at 120 and 220° C. are the most important. It is difficult to believe that these can be of the nature of allotropic changes, and for the time the explanation must be taken as unknown.

2. Under the same conditions carbide of iron possesses two well-marked points at 160 and 200° C. It is not clear whether these are distinct points, or are the ends of a single transformation range.

3. The etching of cementite has been studied. Broadly the reagents which darken cementite are strongly alkaline. No acid and only one neutral solution will do this. A solution has been discovered which will enable the two forms of cementite to be differentiated micrographically, but since β -cementite will change to the α form in a few days at room temperature, this etching is not always satisfactory.

4. When samples of iron and high carbon steel are quenched from 280° C., it is found that the electrical resistivities differ from those obtained by slow cooling. These values are not constant, but as the material tempers they gradually alter, till after the lapse of some days the values practically coincide with those obtained by slow cooling.

C. F. JENKIN: *The Fatigue Failure of Metals.* Communicated by Sir Alfred Ewing, F.R.S.

The paper contains a theory of the mechanism of fatigue failure in metals which explains all the principal phenomena observed in connection with fatigue tests on metals. The theory is demonstrated by means of a simple model which possesses the assumed properties of the crystals

forming the metal. The model, when tested like a metal test-piece, gives stress/strain curves, hysteresis loops, and the complete series of fatigue ranges of exactly the same character as those given by the metal test-piece.

The truth of the theory can be tested in many ways, and experiments are described which have been made for this purpose. Suggestions for further experiments are given: a method of mechanically treating a mild steel test-piece is described, which, according to the theory, should raise its fatigue range about 20 per cent.; another treatment is described which should lower the fatigue range of medium steel by about 25 per cent.

The theory suggests many new lines of investigation.

PROF. S. BRODETSKY: *The Line of Action of the Resultant Pressure in Discontinuous Fluid Motion*. Communicated by Sir George Greenhill, F.R.S.

The general solution of the problem of discontinuous fluid motion past any barrier can be expressed in terms of the variable introduced by Levi-Civita, by means of which the part of the barrier in contact with the moving fluid is transformed into a semi-circle. The form of the barrier is defined by the coefficients in a Taylor expansion.

Although the components of the resultant pressure on the barrier have been calculated in terms of these coefficients, the line of action has not been found, and the object of this communication is to supply the deficiency. The amount of the resultant pressure about a certain point is proved to be a simple function of the first four coefficients of the above expansion, and it is shown how to use the result in actual problems.

DR. R. A. HOUSTOUN: *An Investigation of the Colour Vision of 527 Students by the Rayleigh Test*. Communicated by Prof. A. Gray, F.R.S.

Lord Rayleigh discovered in 1881 that if homogeneous yellow is matched with a mixture of homogeneous red and homogeneous green, some persons require much more red, others much more green in the mixture than the normal. Such persons have been called "anomalous trichromats."

The present paper describes a survey made with an apparatus similar to Rayleigh's and embracing a much greater number of observers. The results are exhibited

in the form of frequency curves.

In the case of the 104 women the frequency curve is almost a perfect case of normal variation; in the case of the men the normal curve is present, and outside of it lie the colour blind and the anomalous trichromats; but the anomalous trichromats are much fewer in number than would be expected from Rayleigh's original paper.

THE ROYAL SOCIETY.

THURSDAY, DECEMBER 7, 1922, AT 4.30 P.M.
Papers read:—

LORD RAYLEIGH, F.R.S.: *Spectrum of Active Nitrogen as affected by Admixture of the Inert Gases*.

G. H. HENDERSON, Ph.D.: *Changes in the Charge of an α -Particle passing through Matter*. Communicated by Sir Ernest Rutherford, F.R.S.

W. T. ASTBURY: *The Crystalline Structure and Properties of Tartaric Acid*. Communicated by Sir William Bragg, F.R.S.

J. N. MUKHERJEE: *Sources of Error in the Measurement of the Electrical Charge of Colloidal Particles by the Method of Moving Boundaries*. Communicated by Prof. F. G. Donnan, F.R.S.

J. HEYROVSKÝ: *The Significance of the Electrode Potential*. Communicated by Prof. F. G. Donnan, F.R.S.

A. M. MOSHARRAFA: *On the Quantum Theory of the Simple Zeeman Effect*. Communicated by Prof. O. W. Richardson, F.R.S.

S. BRODETSKY: *Discontinuous Fluid Motion past Circular and Elliptic Cylinders*. Communicated by Prof. G. H. Bryan, F.R.S.

THE CHEMICAL SOCIETY.

LECTURE.

On Thursday, December 14th, 1922, at 8 p.m., at the Institution of Mechanical Engineers, Storey's Gate, S.W.1, Professor Cecil H. Desch, D.Sc., Ph.D., will deliver a Lecture, entitled: "*The Metallurgical Applications of Physical Chemistry*."

PHYSICAL SOCIETY OF LONDON.

A meeting of the Society was held at 5 p.m. on Friday, December 8, 1922, at the Imperial College of Science, South Kensington, S.W.

AGENDA.

1. *The Relation between Molecular and Crystal Symmetry as shown by X-ray Crystal Analysis*, by G. SHEARER, M.A., B.Sc.
2. *Modification of the Powder Method of Determining the Structure of Metal Crystals*, by E. A. OWEN, M.A., D.Sc., and G. D. PRESTON, B.A.
3. *The Cathode Ray Oscillograph*, by A. B. WOOD, D.Sc.

A demonstration of a "Low Voltage Cathode Ray Oscillograph" was given by the International Western Electric Company.

PROCEEDINGS AT THE MEETING HELD ON NOV. 24, 1922, AT THE IMPERIAL COLLEGE OF SCIENCE.

Alexander Russell, M.A., D.Sc., in the Chair.

A paper on *The Theory of the Singing Flame* was read by Mr. E. G. RICHARDSON, B.Sc.

Abstract.

The various theories of the action of the Singing Flame put forward since its discovery are reviewed, and experiments to test the relative merits of the two most recent theories are described; Lord Rayleigh's theory is shown to fit the results most closely, in that (1) heat is given by the flame to the air in the tube at each condensation, and (2) stationary waves are formed in the gas as well as in the air-tube. But the lengths of gas-tube unfavourable to the "singing" cover, in fact, a much more restricted range than Lord Rayleigh surmised.

A paper on *Unit Surfaces of Cooke and Tessar Photographic Lenses* was read by Miss ALICE EVERETT, M.A.

Abstract.

A number of rays in an axial plane (and a few general rays) are traced through the lens systems by exact methods, and on each ray the positions of the conjugate points for unit magnification are found by Mr. T. Smith's formulæ. The results show that for general rays the loci of these "unit points" are three-dimensional. The loci are surfaces only when the chief rays are

bound by some condition such as passing through a fixed point of the object. In this case the unit surfaces are not fixed, but shift with the object point. The curvature varies with aperture, and with the distance of the object point from the optic axis. Hence the unit surfaces cannot coincide with wave-fronts. Within the region for which the lenses are designed, the curvature of both object and image unit-point loci is positive (convex to the light source) and the image locus is more curved than the object locus. These facts do not coincide with the theoretical conclusions obtained by Mr. Smith for either a thin system or an ideal thick system, but accord more nearly with the latter, especially as regards the sign of the difference of curvatures of the two unit surfaces.

A paper on *Vibration Galvanometers with Asymmetric Moving Systems*, by R. LL. JONES, M.A., was taken as read.

Abstract.

In the theory of the vibration galvanometer with one degree of freedom certain specified conditions are assumed to hold. If these conditions are not satisfied in a galvanometer, the instrument will show multiple resonance. This indicates the need of a more general theory. The theory of vibrations of a system with two degrees of freedom is briefly given, expressions for the amplitudes of the forced vibrations are deduced, and the conditions for resonance ascertained. The results are applied to a galvanometer in which the moving system is asymmetrically hung on a laterally yielding axis, and it is shown that the formula for the amplitude is capable of reproducing with fair accuracy the sensitivity curve of the galvanometer, which shows multiple resonance. Asymmetry always lowers the sensitivity of the resonance, and the loss can be ascertained by the help of the sensitivity curve. The analogy to the vibrations in coupled circuits is pointed out.

I wish to express my gratitude to A. Campbell for helpful criticism, advice and references.

A Demonstration of *Some Applications of the Gyroscope* was given by M. PAUL SCHILOWSKY, Chairman of the Gyroscopic Society, Petrograd.

M. Schilowsky said that the principles of the gyroscope are insufficiently taught in technical colleges, with the result that the subject has received very little attention from the engineering profession. Engineers

are in consequence unduly sceptical as to the applicability of such principles to practical problems, although a staff of some 50 Russian experts, under the speaker's chairmanship, had evolved designs for the construction of a perfectly safe and practicable monorail system for a suburb of Petrograd. The models he was exhibiting were not to scale. In practice the gyrostatic apparatus would form from 3 per cent. to 5 per cent. of the load of a ship, and from 5 per cent. to 10 per cent. of the load of a monorail carriage. The underlying principle of his invention is as follows: To stabilise a system in unstable equilibrium, a reaction must be set up between the system and the gyrostat of such a character as to *help* the precession of the gyrostat during the return of the system to normal. To check the oscillations of a stable system, the reaction must be such as to *oppose* such precession. The gyrostat must, of course, be power-driven to neutralise friction. The exhibits included the following.

(a) A collection of apparatus for teaching purposes, comprising *inter alia* models illustrating the precession of the earth, a method of optically projecting an image of a spinning top, and small monorail models. The above-mentioned principle was illustrated by means of a top which, when spinning on a sharp point, exhibited precession. When, however, the point was furnished with a spherical knob, the top "slept" until its angular momentum was exhausted by friction, when it abruptly collapsed.

(b) Model of a rocking ship. The gyrostatic flywheel is mounted with its axle vertical in a frame, which can both rock about and slide along an axis transverse to the ship. When the ship rolls to starboard the axle of the wheel tilts in precession in a fore-and-aft plane, and at the same time the gyrostat slides bodily sideways under gravity, its frame engaging a rack which holds it with the axle in the tilted position. When the ship begins to roll back, the axle tries to reverse its fore-and-aft tilt, but is prevented by the engagement of the rack, which is spring-controlled. Thus precession is opposed during the return of the ship to normal and (the equilibrium being stable) rolling is checked by the resulting reaction.

(c) Model of an aeroplane carrying a gyrostat. The problem of combining automatic stability with mobility while avoiding dangerous stresses was discussed.

(d) Models of mono-rail gyrostatic ap-

paratus. In the most recent design the flywheel is mounted with its axle vertical in a frame which can tilt in a fore-and-aft plane, and also slide sideways under gravity. The frame is surmounted by a pinion co-axial with and geared down from the flywheel; and the pinion lies between, but normally clear of, two parallel fixed racks mounted on the carriage, and having their lengths in a fore-and-aft direction. When the carriage tilts to one side, the axle of the flywheel tilts forward or backward in precession, and at the same time the gyrostat slides bodily sideways, so that the pinion engages one or other of the two fixed racks. The pinion then climbs back along the rack to its normal position—i.e., in the same direction as the precession which it would exhibit during the righting of the carriage. Thus such precession is aided and (the equilibrium being unstable) the resulting reaction restores the carriage to the upright position.

(e) Angular-velocity indicator for aeroplanes. Angular velocity of the aeroplane about a vertical axis causes a tendency to precess in a goniroscope rotating about an horizontal axis. This tendency is balanced by a gravity control, and the angle moved through in attaining a balance is indicated by a pointer, affording a measure of the required angular velocity.

An account of a *New Balance for Compensating the Temperature Error of Watches and Chronometers* was given by M. PAUL DITISHEIM, La Chaux de Fonds (Switzerland).

Abstract.

The Compensation Balance made from a bimetallic rim cut in two places has been for nearly two hundred years the only method used for equalising the rate of watches and chronometers in heat and cold. An entirely new system is now offered by the hairspring made of "Elinvar," an alloy invented by Dr. Ch. Ed. Guillaume, the elasticity of which is not affected by changes of temperature. Satisfactory timing can thus be obtained up to certain limits with a plain solid uncut balance. This metallurgic solution of the problem of compensation at all temperatures is an important step in the history of watchmaking.

In order to apply the "Elinvar spring" to higher grade watches a new compensation balance has been designed by M. Ditisheim. It is made from a plain monometallic uncut ring into which two very small symmetrical bimetallic blades are inserted

The latter will enable small corrections to be made in order to obtain very fine rates. This adjustment is necessary for compensating small differences between springs resulting from molecular change and mechanical treatment in their manufacture.

SOCIETY OF GLASS TECHNOLOGY.

An interesting ceremony took place in the early part of the meeting of the Society of Glass Technology, held on Wednesday, November 22nd, in the Applied Science Department of the University of Sheffield, when the "Frank Wood" Medal was presented to the successful students in the Department of Glass Technology at the Sheffield University.

Mr. W. M. Gibbons, Registrar of the University, who attended on behalf of the University, said that they all liked to think that the Society of Glass Technology was born in the University, and they were glad at all times to welcome it in their midst. The University had a very warm regard for the study of glass technology.

In 1919 the Society decided to recognise the services Mr. Frank Wood had rendered in connection with its foundation, and handed over to the University a hundred guineas, with the condition that the income should be utilised to provide some reward to students in the glass technology department. It was decided that the reward should take the form of a medal, and that it should be associated with the name of Mr. Frank Wood, in whose honour it had been established. The medal had been designed by Mr. Percy Metcalfe, of the Royal College of Art, at the suggestion of Professor Rothenstein.

Mr. Frank Wood presented the medal to the successful students, Mr. G. G. Middleton and Mr. H. W. Howes, and in doing so expressed appreciation of the honour that had been done him by associating his name with the medal, and asserted that Dr. Turner had been the real backbone of the Society.

Prof. Turner gave a short account of a visit recently paid to Czecho-Slovakia, where he investigated the position of the glass industry and the methods of manufacture. After dealing with the difficult economic situation with which the Czecho-Slovakian glass industry has to struggle, Prof. Turner concluded by saying that "the technical side of the glass industry

has not made anything like the progress that it has in this country. The Bohemian glass industry is living largely on its old tradition and the existing store of knowledge. Machinery scarcely exists for the manufacture of glassware, and the work is carried on largely by hand, as it was before the war. There was a great deal of money made in the industry in the boom years of 1919 and 1920, but very little of that money was put into the business to improve it. In this country we can look with some satisfaction to the fact that, despite E.P.D. taxes, British manufacturers put considerable sums into the improvement and extension of their works and in new plant, and—I am not without hope that the result of these improvements will mean that British manufacturers are able to make their goods cheaper and better. We can definitely say that, in many methods, from a technical point of view, we lead the European Continent at the present time, and I hope the result of that technical superiority will be evident before many months have passed.

A paper on the use of Selenium in the production of colourless glass, given by Mr. A. Cousen, A.R.C.S., was of great interest to both manufacturers and technical men present. Mr. Cousen gave details of a large number of experimental melts made to determine the effect of various batch materials on the decolourising power of selenium. Some unexpected and very interesting results were obtained. Details were also given of another series of melts in which the effect of the duration of melting on the colour developed was shown.

During the morning the members visited the works of the Parkgate Iron and Steel Co., Ltd., and took part in a very interesting tour of inspection.

GEOLOGICAL SOCIETY OF LONDON.

At the meeting held on November 22nd, PROF. ARTHUR STANLEY EDDINGTON, M.A., F.R.S., PRES. R.A.S., delivered a lecture on *The Borderland of Astronomy and Geology*.

He considered first, in reference to rival hypotheses as to the origin of the Earth and the solar system, the general evolution of the stellar universe. The trend of modern astronomy is against the view that luminous stars are being formed by collisions of extinct stars (unless very excep-

tionally); the stars now observed have systematic relations one to the other, apparently indicating that they have been formed as the result of a single evolutionary process sweeping across the primordial matter. Collisions, in any case, would be extremely rare, since dynamical arguments indicate that extinct stars cannot greatly outnumber the observed luminous stars. Whether the original matter was gaseous or meteoric, it must have become entirely gaseous at a very early stage in the formation of a star: this is inferred from the fact that the masses of stars differ very little one from the other, and agree numerically with a certain critical mass, predicted theoretically for a sphere of gas, but unexplained if the star consisted of a swarm of meteorites. It is supposed that radiation-pressure was instrumental in breaking up the original matter into separate stars. These considerations favour the nebular hypothesis; but, if we accept Jeans's suggestion that the solar system is an exceptional formation, and that undisturbed stars cannot give birth to a planetary system, the argument is less cogent, since it refers only to stars developing normally. Astronomy now demands a great enlargement of Lord Kelvin's time-scale for the age of the sun; the most direct evidence is obtained from Cepheid variables, which are found to be developing at only $1/500$ of the rate which Kelvin's hypothesis assumed. The sun must at one time have given out from 20 to 50 times as much heat as it emits now; but it is uncertain whether any geological strata go back to an epoch when the sun was sensibly hotter than now. Darwin's views on tidal evolution and the origin of the earth-moon system seem to have held their own against all criticism. The present rate of lengthening of the day (deduced from ancient eclipses) is about 1 minute in six million years; it is, therefore, difficult to date the birth of the moon later than 1,000 million years ago. There seems to be no objection to the postulate that the Earth had a cool solid crust at the time of the catastrophe, if that would explain geological observations; the Pacific Ocean may be the depression which was left, and may have received the waters which formerly covered most of the Earth. The dissipation of energy by the tides occurs chiefly in the land-locked shallow seas, G. I. Taylor having shown that the Irish Sea alone accounts for $1/50$ of the whole amount. The brake on the Earth's rotation is thus a surface-

brake; and the hypothesis suggests itself that there may be a slip of the outer crust over the interior at the "zone of weakness." If the slip is irregular, this would help to explain certain astronomical observations of irregularities in the longitudes of the moon, sun, and planets. It might even be the cause of the motion of the magnetic poles. The brake, being applied irregularly over the surface, would also tend to crumple the crust. The postulated looseness of the crust might also permit the North Pole to move about over the surface; but exceedingly long periods of time would be required, since there is no systematic tendency of the crust to move in latitude.

THE OPTICAL SOCIETY.

EXTRAORDINARY GENERAL MEETING.

An Extraordinary General Meeting of the Society, called by the President at the request of the Council, under Rule 21, was held at the Imperial College of Science and Technology, at 7.30 p.m., on Thursday, 14th December, 1922. The following addition to Rule 7 (Corporate Membership) was proposed and adopted:—

"At the request of a Fellow or Member of more than one year's standing, the Council may, by special resolution, transfer his membership to a specified Partnership Firm, Company, or other Corporate Body, with which he is associated. Such body may then be admitted to Corporate Membership in accordance with the preceding section of this Rule, but without the payment of an entrance fee, provided that the Fellow or Member then resigns in accordance with the conditions specified in Rule 10, and that if the subscription for Corporate Membership be greater than that paid for the current year by the Fellow or Member resigning, the difference be paid by the Corporate Member so admitted."

ORDINARY MEETING.

Immediately after the Extraordinary General Meeting, an Ordinary Meeting of the Society was held, when the following papers were presented and discussed:—

A Large Aperture Lens not Corrected for Colour, by T. SMITH, M.A., F.INST.P.

The Optical Cosine Law, by T. SMITH, M.A., F.INST.P.

Demonstrations were given of:

The Measurement of the Internal Diameters of Transparent Tubes, and A Simple Differential Refractometer for Liquids, by Dr. I. S. ANDERSON, M.A., F.INST.P.

There was also an exhibit and description of a *Constant Bubble* (unaffected in length by changes of temperature), by Messrs. E. R. Watts & Son, Ltd.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

The annual dinner of the Liverpool Section was held at the Liverpool Adelphi Hotel on Saturday night, Dr. F. J. Brislée (Chairman of the Liverpool and North-Western Counties' Association of the Institute of Chemistry) presiding over a large gathering of ladies and gentlemen, who spent an enjoyable time.

The principal guests included the Lady Mayoress, Sir Max Muspratt, Dr. and Mrs. E. F. Armstrong, Ald. and Mrs. Muirhead, the Hon. and Mrs. W. Hulme Lever, Mr. and Mrs. W. Moon, Dr. J. P. Longstaff (General Secretary of the Society of the Chemical Industry), Mr. H. Ballantyne (Vice-President of the Institute of Chemistry), Mr. R. B. Pilcher (Registrar of the Institute of Chemistry), and Dr. G. C. Clayton, M.P., and Mrs. Clayton.

The Chairman expressed his pleasure that the ladies had come to such a gathering, for they had a sphere of work wholly different from the men, and could do work with their delicate touch which could not be done by the coarser methods of mankind. He proposed the toast of "Our Guests," and the response was made by Dr. Armstrong, F.R.S., President of the Society of Chemical Industry.

Dr. Armstrong declared that his position was most difficult, and he felt that he would like to repeat an expression he heard in the States and then sit down, and the expression was, "We are glad to have you know us." (Laughter.) Now that Dr. Clayton had got into Parliament, they hoped that the lot of chemists would be materially improved. (Applause.) They might talk a great deal about the influence of chemistry on women, but he would ask, "Where would chemistry be without women?" The British dyestuffs would not even try to exist. (Laughter.) They would

not have all those troubles about Protection and Free Trade about the British dyestuffs. (Laughter.) Then, again, what would be the use of aspirins if there were no women in the world? (Laughter.) Many societies appealed to chemists and people engaged in the chemistry profession, but the two societies which had made the most progress during the last five years were the Institute of Chemistry and the Society of Chemical Industry. (Applause.) He hoped they would come together in the future, because he felt if they spoke with one voice, and the ladies spoke with them and for them, they would be able to attain to the position they desired. (Applause.)

The Chairman, replying to the toast of his health, said it was during the war that chemistry was really discovered and found to be of national importance. They must not let the lesson be forgotten. Speaking of the great principles of the two societies with which they were connected, he said their sign manual was "professional efficiency." With such a combination, he thought the progress of chemistry in this country was assured. In the future chemistry would play a far greater part in the economics of everyday life than in the past. One had only to look at the appalling waste of production through inefficient methods of manufacture—fuel need only be mentioned in that connection—to become convinced that a large amount of expert investigation was necessary to carry them on to the golden age they hoped to reach in the future. (Applause.)

An enjoyable musical evening was spent by the guests, some of whom accepted the invitation of the hotel management to join the dancers in the magnificent ballroom.

GENERAL NOTES.

ENCOURAGING THE USE OF ELECTRICITY.

To stimulate interest in certain urgent electrical problems, *The Electrician* is arranging a series of competitions, and is allocating £250 in prize money. These competitions will be open to all persons without distinction of age, sex, or nationality, and will be held at quarterly intervals during 1923. The first will be for designs for the cheapest and best electrical installation for an "all-electric" house. The

second will call for a solution of the problem of how hot water can best be obtained electrically. The third will require a scheme to be prepared for the lighting of a village hall electrically. It is anticipated that not only will some interesting solutions be sent in, but that the results will stimulate electrical progress and lead to the cheaper and more efficient use of electricity. Full particulars of competitions are being published in *The Electrician*.

NOTICES OF BOOKS.

Synthetic Colouring Matters. Dye-stuffs derived from Pyridine, Quinoline, Acridine and Xanthene, by J. T. HEWITT, M.A., D.Sc., Ph.D., F.R.S. Pp. XI. + 405. London: Longmans, Green & Co., 39, Paternoster Row, E.C. 1922. Price 14s.

In the first two chapters of this monograph (one of those on Industrial Chemistry under the editorship of Sir Edward Thorpe), Prof. Hewitt deals with pyridine and quinoline and their homologues, and has made reference to the recent and most convenient methods adopted for the preparation of these bases and their derivatives.

It is interesting to note that certain of these have attracted attention recently since they are used to make dyes employed in sensitising photographic plates.

The chemistry of the cyanines and isocyanines is carefully described, and the application of the numerous products and derivatives receives adequate and authoritative treatment.

An account of the pyrone ring and oxonium salts is given, and this is followed by chapters on fluorone and fluorim compounds, and the pyronines and rosanines.

The number of synthetic dyes continues to increase almost to the point of confusion, so that few but specialists in this particular branch of organic chemistry can hope to keep in touch with the latest developments except by the perusal of such a book as this.

In his preface, Prof. Hewitt states that much information has necessarily been obtained from the patent literature, and it is hardly requisite to point out that a specification does not always contain the whole truth and nothing else.

Great care has evidently been taken to secure the latest information concerning these bases and the dyes to be obtained from them. The indexes and references appear to be very complete. Chemists,

technologists, and others will find this monograph a very reliable guide and source of information concerning these synthetic colouring matters. J.G.F.D.

Annual Tables of Constants and Numerical Data—Chemical, Physical and Technological; (Tables Annuelles de constantes et données numériques de Chimie, de Physique et de Technologie). Vol. IV., Part I., Pp. XXXII. + 626. Part II., Pp. XXV., and 627—1377. Publisher for the British Empire: Cambridge University Press, Fetter Lane, London, E.C.4. 1922. Price £7.

The publication of these Annual Tables of Constants, which was discontinued during the war, is being resumed; the Committee responsible has now published Volume IV., in which are collected numerical data gathered from the scientific and technical papers, 1913-1916 inclusively.

The work, which is one of great magnitude, is now under the high authority of the "International Union of Pure and Applied Chemistry," and of the "International Research Council."

In its task, the Committee had to overcome great difficulties. In view of supporting the Committee, the "Union of Pure and Applied Chemistry" decided to form an "International Fund." Both France and the United States gave their adhesion in June, 1922; their subscription amounts to half the necessary sum. It is greatly to be hoped that the various countries in which an effective scientific and technical development has been reached will join without delay: their agreement would enable the Committee to publish Volume V., the matter for which is ready at hand. This book is to contain numerical data collected from 1917 to 1922 inclusively.

The importance of such numerical data is rendered clearly manifest day by day. Besides the names of practically all the scientific establishments of the world, the lists of subscribers contain those of a considerable number of firms dealing with the most varied branches of industry: Chemistry, Metallurgy, Electricity, Electro-Chemistry, Mechanics, etc., who are aware of the technical improvements to be derived therefrom, and of the financial changes brought in its train.

They are also aware that such information cannot be gathered by the ordinary bibliographic method, but only by carefully studying every separate scientific and technical periodical page by page.

Year-Book of Pharmacy and Transactions of the British Pharmaceutical Conference, Nottingham, 1922. J. & A. Churchill, 7, Great Marlborough Street. 1922.

The above year book, just issued, gives a fund of information valuable both to the pharmaceutical and the analytical chemist. The notes arranged alphabetically contain all the advances that have appeared in British and foreign journals throughout the year, the section devoted to inorganic chemistry embraces many items of value that have appeared in publications not generally accessible to the student in chemistry. Among the "notes and formulæ" an abstract is given of a paper that appeared in the *Analyst*, on the use of Ultra-Violet Light in Analysis. The value of these rays in analysis is very considerable, and now that it is easy to obtain a beam of U.V. rays by anyone who has a half-watt lamp is available. The method of investigation is likely to be largely used.

The latter half of the book gives a full report of the British Pharmaceutical Conference, held in July last, at University College, Nottingham. The Presidential address by Professor H. G. Greenish, whose portrait appears on the front page, is exceedingly interesting reading.

The book contains the usual authors' and subject index, giving very full references.

BOOKS RECEIVED.

The Mysteries of Hymosis, by GEORGES DE DUBOE. Pp. IX. + 235. 1922. Messrs. William Rider & Son, Ltd., 8, Paternoster Row, E.C.4. 5s. net.

Joannes Baptista van Helmont, Alchemist, Physician and Philosopher, by H. STANLEY REDGROVE and I. M. F. REDGROVE. Pp. 86. 1922. Messrs. William Rider & Son, Ltd., 8-11, Paternoster Row, E.C.4. 2s. net.

Oxidations and Reductions in the Animal Body, by H. D. DAKIN, D.Sc., F.I.C., F.R.S. Second Edition. 1922. Pp. VI. + 176. Messrs. Longman, Green & Co., 39, Paternoster Row, E.C.4. 6s. net.

Tables Annuelles de Constantes et Données Numériques de Chimie de Physique et de Technologie; Annual Tables of Constants and Numerical Data, Chemical, Physical and Technological. Pp. 1,377. Vol. IV., two Parts. 1921 and 1922 (years 1913, 1914, 1915, 1916). Gauthier Villars et Cie, Paris. Cambridge University Press, Cambridge. £7.

Discoveries and Inventions of the Twen-

tieth Century, by EDWARD CRESSY. Pp. XXIII. + 453. Second Edition. 1922. Messrs. George Routledge & Sons, Ltd., Broadway House, 68-74, Carter Lane, E.C.4. 12s. 6d. net.

Flavouring Material, Natural and Synthetic, by A. CLARKE, F.C.S. Pp. XX. + 166. 1922. Messrs. Henry Frowde and Hodder & Stroughton, The Lancet Building, 1, Bedford Street, Strand, W.C.2. 8s. 6d. net.

A Dictionary of Applied Chemistry, by SIR EDWARD THORPE, C.B., LL.D., F.R.S. Pp. VIII. + 740. Vol. IV. 1922. Messrs. Longmans, Green & Co., 39, Paternoster Row, E.C.4. 60s. net.

Chemical Engineering Catalog, by COMMITTEE OF 'THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.' Pp. 1,187. Seventh Annual Edition. 1922. The Chemical Catalog Co. Inc., 19, East 24th Street, New York. 10 Dollars.



This list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

31329—Bewsher, J. N.—Valves for acids, etc. Nov. 16.

31596—Gas Light & Coke Co.—Conduct of chemical reactions involving use of gases, etc., under pressure. Nov. 18.

31597—Gas Light & Coke Co. Crystallization Nov. 18.

Abstract Published this Week.

Dyes' Intermediate Products. Patent No. 186517.—Some important improvements in the manufacture of dyes and in their intermediate products have been Patented by Messrs. British Dyestuffs Corporation, Ltd., Imperial House, Kingsway, London.

Triarylmethane dyes containing a thiazole ring are prepared by condensing tetramethyldiaminobenzhydrol or equivalent tetraalkyldiaminobenzhydrol (in which one or two alkyl groups may be replaced by benzyl groups) with an arylbenzthiazole and oxidizing the resulting leuco compound. According to examples, tetramethyldiaminobenzhydrol is condensed with 1-phenyl-5-methylbenzthiazole, 4-methoxy-1-phenyl-5-methylbenzthiazole, or dehydrothiitoluidine, and the leuco bases oxidized; the leuco base from dehydrothiitoluidine may be acetylated, or, according to the Provisional Specification, it may be alkylated or treated with phosgene. The products dye wool or tannin-mordanted cotton and also unmordanted cotton or paper, bright green shades.

1-Phenyl-5-methylbenzthiazole is prepared by heating benzyl-p-toluidine with sulphur.

4-Methoxyl-1-phenyl-5-methylbenzthiazole is prepared by methylating 4-oxyl-1-phenyl-5-methylbenzthiazole with methyltoluene sulphonate.

Messrs. Rayner & Co. will obtain printed copies of the published Specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3721.

ROYAL INSTITUTION OF GREAT BRITAIN.

JUVENILE CHRISTMAS LECTURES.

Three O'clock Afternoon.

Six Steps up the Ladder to the Stars, by HERBERT HALL TURNER, D.Sc., D.C.L., F.R.S., Savilian Prof. of Astronomy, Oxford.

NINETY-SEVENTH COURSE ADAPTED TO A JUVENILE AUDITORY (ILLUSTRATED).

(I) *The Distance of the Stars*; (II) *The Discovery of the Planet Neptune*; (III) *Photographing the Stars*; (IV) *The Spectroscope and its Revelations*; (V) *Two great Streams of Stars*; (VI) *The Size of a Star*.

(I) Thursday, Dec. 28; (II) Saturday, Dec. 30; (III) Tuesday, Jan. 2; (IV) Thursday, Jan. 4; (V) Saturday, Jan. 6; (VI) Tuesday, Jan. 9.

The members of the Royal Institution have the sole right of obtaining tickets for the Christmas Lectures until December 18. There may be a limited number of tickets available for the use of non-members after December 20.

Juveniles between ten and sixteen years of age, half-a-guinea; adults, two guineas.

LECTURES BEFORE EASTER, 1923.

Friday Evening Discourses Addressed to Members and their Friends, at 9.0 p.m.

January 19: SIR JAMES DEWAR, LL.D., F.R.S., M.R.I., Fullerman Prof. of Chemistry, *Soap Films as Detectors; Stream Lines; Vortex Motion; and Sound*.

January 26: SIR ALMROTH WRIGHT, K.B.E., C.B., M.D., Sc.D., F.R.S., M.R.I., *The Machinery of Anti-Bacterial Defence*.

February 2: CHARLES F. CROSS, B.Sc., F.R.S., M.R.I., *Fact and Phantasy in Industrial Science*.

February 9: SIR JOHN RUSSELL, O.B.E., D.Sc., F.R.S. (Director of the Rothamsted Experimental Station), *"Rothamsted" and Agricultural Science*.

February 16: A. V. HILL, O.B.E., Sc.D., F.R.S. (Prof. of Physiology, University of Manchester), *Muscular Exercise*.

February 23: A. S. EDDINGTON, F.R.S., PRES.R.A.S. (Plumian Prof. of Astronomy,

University of Cambridge), *The Interior of a Star*.

March 2: GEORGE C. SHIPSON, C.B.E., D.Sc., F.R.S. (Director Meteorological Office), *The Water in the Atmosphere*.

March 16: MONTAGU R. JAMES, Litt.D., F.S.A., F.B.A. (Provost of Eton), *The Novels and Stories of J. Sheridan Le Fanu*.

March 23: SIR ERNEST RUTHERFORD, LL.D., D.Sc., F.R.S., M.R.I. (Prof. of Natural Philosophy; and Cavendish Prof. of Experimental Physics, University of Cambridge), *Life History of an Alpha Particle from Radium*.

GENERAL COURSES OF LECTURES BEFORE EASTER, 1923.

Three O'clock Afternoon.

Tuesdays, January 16 and 23: *Semi-Permeable Membranes and Colloid Chemistry*. 1: *The Theory of Ionic Equilibria and Semi-Permeable Membranes*; 2: *Relation to Problems of Colloid Chemistry and Biology*, by F. G. DONNAN, C.B.E., D.Sc., F.R.S., M.R.I. (Prof. of Inorganic and Physical Chemistry, University of London).

Tuesdays, January 30, February 6: *The Character and Cause of Earthquakes*, by R. D. OLDHAM, F.R.S.

Tuesday, February 13, Wednesday, February 21: *Greek Civilisation and To-day*.—1: *The Beginnings of Science*; 2: *Progress in the Arts*; by A. C. PEARSON, Litt.D. (Regius Prof. of Greek, University of Cambridge).

Tuesdays, February 27, March 6: *Life and Its Rhythms*.—1: *Life and Its Attributes*; 2: *Rhythm in Living Organisms*; by SIR ARTHUR E. SHIPLEY, G.B.E., Sc.D., F.R.S. (Master of Christ's College, Cambridge).

Tuesdays, March 13, 20: *Rainmakers and Divine Kings of the Nile Valley*, by CHARLES G. SELIGMAN, M.D., F.R.S. (Prof. of Ethnology, University of London).

Thursdays, January 18, 25: 1: *The British Soldier and Regimental Officer at the close of the Napoleonic Wars*; 2: *The Campaigns of the British Army, 1815-38*; by THE HON. JOHN W. FORTESCUE, C.V.O., LL.D. (Librarian at Windsor Castle).

Thursdays, February 1, 8: *The Photosynthesis of Plant Products*, by I. M. HEILBRON, D.S.O., D.Sc., Ph.D., F.I.C. (Heath-Harrison Prof. of Organic Chemistry, University of Liverpool).

Thursdays, February 15, 22: *Recent Experiments in Aerial Surveying*, by B. MELVILL JONES, M.A. (Francis Mond Prof. of

Aeronautical Engineering, University of Cambridge).

Thursdays, March 1, 8: *Water Power of the Empire*, by THEODORE STEVENS, B.MET., MIN.ENG., M.INST.C.E., M.I.E.E.

Thursdays, March 15, 22: *Japanese and Chinese Lacquer*, by LIEUT.-COL. E. F. STRANGE.

Saturdays, January 20, 27: *Speech Rhythm in Vocal Music*, by SIR WALFORD DAVIES, MUS.DOC., LL.D. (Director of Music in the University of Wales), with illustrations by members of the Temple Choir.

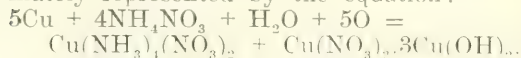
Saturdays, February 3, 10: Subject in Poetry (with special reference to contemporary practice), by J. C. SQUIRE, M.A. (Cambridge), Editor *London Mercury*.

Saturdays, February 17, 24, March 3, 10, 17, 24: *Atomic Projectiles and Their Properties*, by SIR ERNEST RUTHERFORD, LL.D., D.Sc., F.R.S., M.R.I. (Prof. of Natural Philosophy, and Cavendish Prof. of Experimental Physics, University of Cambridge).

ACTION OF AMMONIUM NITRATE AND AQUEOUS AMMONIA ON COPPER.

By H. BASSETT AND R. G. DURRANT.

The authors remark that ammonium nitrate effects a corrosive action on copper, and such is important in the manufacture of munitions. Explosives containing ammonium nitrate are liable to cause corrosion of shell cases in the presence of moisture. Atmospheric oxygen seems essential in the reaction. The products of corrosion consist of cupric tetrammine nitrate $\text{Cu}(\text{NH}_3)_4(\text{NO}_3)_2$, which is in the form of dark blue prismatic crystals, and also basic copper nitrate $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{Cu}(\text{OH})_2$. The sum total of the reaction may be approximately represented by the equation:



In actual corrosion, the two copper compounds are not found in equimolecular quantities, owing to secondary reactions such as the hydrolysis of the tetrammine, etc.

By immersing copper gauze in saturated ammonium nitrate, the basic nitrate is quickly formed, while if the gauze projects above the surface of solution, the tetrammine will also be produced. This latter substance melts at 210°C. , and explodes

at 212° , leaving cupric oxide as a residue. It slowly hydrolyses in moist air to the basic nitrate.

The formation of nitrate when copper is left in a solution of ammonia, results from the oxidation of the ammonia. The authors have shown that when finely divided copper is allowed to react with ammonia in the presence of air, the formation of cupric tetrammine nitrite occurs (cf *Peligot, Compt. rend.*, 1861, LIII., 209), and several methods are described for preparing this compound.

When this substance is carefully heated for 24 hours at 97°C. , cupric diammine nitrite $\text{Cu}(\text{NH}_3)_2(\text{NO}_2)_2$ is formed, while if exposed to moist air, it gives up half its ammonia with the formation of the diammine nitrite, and finally by hydrolysis there is formed the basic nitrite.—(*Trans. Chem. Soc.*, 1922, p. 2630.)

RESEARCH WORK AT BIRMINGHAM UNIVERSITY.

An interesting account of important research work which has recently been carried out at the Chemical Department of the University of Birmingham by Professor G. T. Morgan, F.R.S., and student collaborators, was given on Tuesday night, December 5, at that University, at a special meeting of the Society of Chemical Industry, in conjunction with the Chemical Society. There was a representative attendance, and Dr. Edward B. Maxted presided.

Paper I.:

Researches on Residual Affinity and Co-ordination, by PROF. GILBERT T. MORGAN and MR. HARRY GORDON REEVES, M.Sc.

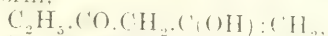
This was Part XV. of the researches, and dealt with interactions of acetyl-propionyl-methane and the tetrachlorides of selenium and tellurium.

Acetylacetone has the noteworthy property of forming derivatives with the majority of chemical elements. In some cases these derivatives have remarkable characteristics, for instance, the acetylacetones of aluminium, beryllium, chromium, manganese, and scandium can be distilled without decomposition. In the words of the late Sir William Crookes, this reagent "has given wings to the metals."

Acetyl-propionyl-methane (propionylacetone), preferably in the form of its copper derivative, behaves towards selenium tetra-

chloride in its ordinary monocyclic modification, $C_2H_5.C(OCH_3).CH.CO.CH_3$, and yields selenium acetyl-propionyl methane, $Se_2(C_6H_8O_2)_2$.

With tellurium tetrachloride, acetyl-propionyl-methane reacts in its methylene enolic form,



giving rise to tellurium acetyl-propionyl-methane-di-chloride $(C_6H_8O_2)_2TeCl_2$. On reduction this dichloride furnishes tellurium acetyl propionyl-methane, $Te(C_6H_8O_2)_2$, a substance having an intense bactericidal action.

Paper II.:

The Upper Limit of Diazotisability in the Benzene Series (Diazo-derivatives of Mesitylene), by PROFESSOR MORGAN and MR. GLYN REES DAVIES, M.Sc.

Professor Morgan observed that the subject had a Midland interest, in that the diazo-reaction, which was the most important general reaction in the chemistry of coal tar products, was first investigated by Peter Griess, about 60 years ago, in the chemical laboratories of Messrs. Allsopp & Co., of Burton-on-Trent. Griess studied the diazotisation of monoamines and diamines of the aromatic series, and laid the foundation of the manufacture of azo-dyes, but hitherto no one had examined the behaviour of a simple aromatic triamine towards nitrous acid.

When treated with three molecular proportions of nitrous acid, tri-amino-mesitylene hydrochloride in acid solution is diazotised only in two of its amino groups, yielding amino-mesitylene-bis-diazonium-chloride identified by conversion into amino-mesitylene-bis-azoimide, $NH_2.C_6H_3N_6$, and the aurichloride hydrochloride, $HCl.NH_2.C_6H_3(N_2.AuCl_4)_2$.

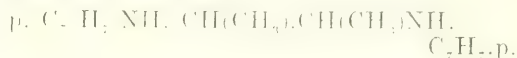
When, however, this diazotisation with excess of nitrite is effected in presence of hydrazoic acid, the formation of the foregoing bistriazo compound is followed immediately by the diazotisation of the third amino group, thus leading to the production of tris-triazo mesitylene, $C_6H_3N_9$.

It is inferred from these results that in a monocyclic triamine of the benzene series, only two or the three amino groups can be diazotised concurrently. The diazotisability of the third amino group is manifested only after the two first formed diazonium complexes have been substituted by other groups such as the triazo radicle.

Paper III.:

Studies in the Normal Butyl Series.—Part II.: *The 4 Stereoisomeric $\beta\gamma$ di-p-tolyl-amino-n-butanes*, by PROFESSOR MORGAN and Mr. W. J. HICKINBOTTOM, M.Sc.

Professor Morgan pointed out that stereochemistry was first systematically studied by Louis Pasteur, 70 years ago, when he showed that at temperatures below 28° an aqueous solution of sodium ammonium racemate furnished crystals of two optically active sodium ammonium tartrates. Each of these salts possessed the property of rotating the plane of polarised light, but in one case the rotation was to the right, whereas in the other it was to an equal degree towards the left. Pasteur also discovered a fourth modification of tartaric acid, mesotartaric acid, which could not be resolved into optically active components. When $\beta\gamma$ -dichloro-n-butane or the corresponding dibromo-compound is condensed with p-toluidine, two isomeric diamines are produced having the same graphic formula,



The less fusible isomeride, is a racemoid substance resolvable by the aid of d- γ -bromocamphor-R sulphonic acid, into two optically active enantiomorphs.

d- and *l*- $\beta\gamma$ -di-p-tolyl-amine-n-butane.

The more fusible isomeride, which is non-resolvable, is meso- $\beta\gamma$ -di-p-tolylamine-n-butane.

These four stereoisomeric modifications of the same diamine furnish a complete analogy with the four stereoisomeric tartaric acids, this being the first instance in which a complete set of four basic substances containing two asymmetric carbon atoms has been isolated in definitely crystalline forms.

During the condensation between p-toluidine and the di-halogenated n-butanes a basic by-product is isolated, yielding characteristic bright yellow salts; this base has been identified as 3:5:7 tri-methyl acridine.

Reference was made by the Chairman to the active and productive work which is being done at the Chemical Department of the Birmingham University.

GENERAL NOTES.

DISTRIBUTION OF GERMAN DYES.

In the House of Commons last week, Mr. Charles Roberts asked the President of the Board of Trade when the Central Import Agency, which had acted as Government agents for the disposal of dyes received from Germany under reparations, closed down; and could he state what profit and loss was made by this agency on the sale of these dyes?

Sir P. Lloyd Greame replied: The British Dyestuffs Corporation, Ltd., were appointed agents for the Board of Trade in respect of the distribution of reparation dyestuffs, as it appeared in all the circumstances a better arrangement than the existing one. The change took effect as from the 1st September, but a Press announcement was deferred until some modifications in the terms of sale of the dyestuffs could be included in it. The agreement with the Corporation is terminable at any time by three months' notice on either side. The Corporation receives a commission of $6\frac{1}{2}$ per cent. on the gross turnover, plus a further 1 per cent. for guaranteeing accounts, and this commission covers all charges relating to the importation of the dyestuffs from Germany, storage in the United Kingdom, packing, etc., but the Board have agreed to make a maximum annual grant of £30,000 towards the cost of such charges. I am not aware of any foundation for the suggestion that any information obtained by the Corporation in the conduct of the agency is being improperly utilised. The new arrangement has met with the approval both of the Colour Users' Association and Dye Manufacturers other than the British Dyestuffs Corporation. With regard to the last part of the question by the hon. member for Derby, I am not in a position to make any statement, as the company carrying on the agency was paid on a commission basis, which, however, it is proposed to revise, since it is now shown that the original terms as agreed were inadequate.

SODIUM HYPOSULPHITE.

Mr. Roberts asked the President of the Board of Trade if he would state the minimum degree of purity of imported sodium hyposulphite above which the chemical is liable to duty under Part I. of the Safeguarding of Industries Act.

Sir P. Lloyd-Greame replied: Sodium hyposulphite is dutiable when it is of photographic quality, or of still higher quality. Photographic quality hyposulphite is a well-known trade quality, but there is no fixed quantitative standard to which it must conform, and any hyposulphite which would be good delivery against an order for sodium hyposulphite "photographic quality" is dutiable.

POTASSIUM PERMANGANATE.

Mr. Foot asked the President of the Board of Trade whether he was aware that under the item R. potassium permanganate, scheduled in the list of articles liable to duty under art I. of the Safeguarding of Industries Act, the Customs were levying the duty on importations of potassium permanganate of commercial quality that was for use for industrial purposes; and, in view of the fact that the R. quality was only meant to refer to the pure quality, would he instruct the Customs accordingly.

Mr. Stanley Baldwin, Chancellor of the Exchequer, replied: The answer to the first part of the question is in the negative. Duty is not charged by the Customs on permanganate of potash unless of R. quality. I may remind the hon. member that if a claim for duty on a specific consignment is disputed on the ground that the goods are not of dutiable quality, it is open to the importer to apply to have the matter referred to a referee under Section II. of the Safeguarding of Industries Act.

ALUMINIUM SULPHOCYANIDE.

Mr. Foot asked the President of the Board of Trade whether he was aware that, though on the 6th of April last aluminium sulphocyanide, barium sulphocyanide, and copper sulphocyanide were stated to be deleted from the list of articles scheduled as liable to duty under the Safeguarding of Industries Act, potassium sulphocyanide and sodium sulphocyanide were still retained in the list of scheduled products; and, if so, could he say for what reason the latter two had not been removed from the list and from liability to duty on importation.

Sir P. Lloyd-Greame replied: The items, aluminium sulphocyanide, barium sulphocyanide, and copper sulphocyanide, were removed from the lists because certain observations made by the referee in his deci-

sion in the cream of tartar case indicated that he would probably regard the three chemicals in question as heavy chemicals. These observations do not apply to potassium sulphocyanide and sodium sulphocyanide, and accordingly the lists were not amended in respect of these two substances.

THE CHEMICAL INDUSTRY.

During a debate in the House of Commons on a motion to repeal the Safeguarding of Industries Act, Sir P. Lloyd-Greame, the President of the Board of Trade, referred to the British Chemical Industry, and said that chemicals were developing on all hands. If it were true that the industries of peace in the future were going to depend largely on science, and particularly on chemical science, that meant that to have the chemical industry developed in this country was of the utmost importance. The development of scientific instruments was so good that people preferred to buy them in this country rather than abroad.

PROCEEDINGS OF SOCIETIES.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS.

ORDINARY MEETING, 6TH DECEMBER, 1922.

Held at the Chemical Society's Rooms, Burlington House, Mr. P. A. Ellis Richards (President), in the chair.

Certificates were read for the first time in favour of:—

Messrs. George Henry Appleyard, F.I.C., John Matthew Wilkie, B.Sc., F.I.C., Arthur William Starey, A.R.C.S., B.Sc., A.I.C., James Walter Black, B.Sc. (Lond.).

Certificates were read for the second time in favour of:—Messrs. Henry Aldous Bromley, Robert Faraday Innes, Osman Jones, F.I.C., Alan West Stewart, D.Sc. (Brux.), A.I.C., William Heaton Thorns, Walter Horace Clulow, William Plenderleith Lewelen Hope.

The following were elected members of the Society:—Messrs. Frederick John Martin, M.A. (Cantab), A.I.C., George Scott Robertson, D.Sc. (Dun.), F.I.C., Frederick Stanley Shadbolt, A.I.C.

The following papers were read:—

A Note on the Estimation of Form- and Acet-aldehydes, by E. W. BLAIR, B.Sc.,

D.I.C., A.I.C., and T. SHERLOCK WHEELER, B.Sc., A.R.C.Sc.I., A.I.C.

A Sliding Scale for the Convenient Titration of Strong Liquids by Dilution and Use with Aliquot Parts, by C. H. DOUGLAS CLARK, B.Sc., D.I.C., A.I.C.

Note on the Presence of Sulphur Dioxide in Cattle Foodstuffs after Fumigation, by H. A. PEACOCK, B.Sc.

Some Observations with regard to the Unsaponifiable Matter and Sterols of Edible Fats, by D. W. STEUART, B.Sc.

Note on the Sulphuric Acid Test for Fish Liver Oils, by NORMAN EVERS, B.Sc., F.I.C., and H. J. FOSTER.

Abstract.

A Note on the Estimation of Form- and Acet-aldehydes, by E. W. BLAIR, B.Sc., D.I.C., A.I.C., and T. SHERLOCK WHEELER, B.Sc., A.R.S.Sc.I., A.I.C.

In investigations into the action of oxygen and ozone on various hydrocarbons, the authors found it necessary to devise accurate methods of analysing solutions containing mixtures of formaldehyde and acetaldehyde, and of formaldehyde, hydrogen peroxide, formic acid and a trace of ozone. When formaldehyde and acetaldehyde were present, satisfactory results were obtained by estimating the total aldehydes by Ripper's bisulphite method (*Monat. fur. chem.*, XXI., 1079), and formaldehyde alone by the cyanide method. In solutions containing formaldehyde, formic acid, hydrogen peroxide, and a trace of ozone, these substances were estimated seriatim, formic acid with N/100 alkali, ozone with neutral potassium iodide, hydrogen peroxide by Kingzett's method (*Analyst*, IX., 6), and formaldehyde by Romijn's method, suitable precautions in the application of these methods being taken.

Abstract.

Note on the Presence of Sulphur Dioxide in Cattle Foodstuffs after Fumigation, by H. A. PEACOCK, B.Sc.

Cattle cake which had been stored in a building fumigated with burning sulphur was submitted for analysis with a view to ascertaining if any sulphur dioxide had been absorbed. None was found. Experiments were carried out in the fumigation of cattle cakes and meals, with subsequent examination for sulphur dioxide. So far as the experiments have gone it is concluded that:—

(1) Sulphur dioxide may be absorbed by cattle cakes and meals during fumigation, but that after about a week the sulphur dioxide disappears.

(2) The amount of sulphur dioxide absorbed seems to depend on the variety of cake, the harder cakes absorbing less than the softer, and the condition of the feeding stuff, *i.e.*, whether in block or powder form.

(3) Any deleterious effect, commonly ascribed to the consumption of sulphured feeding stuffs by farm stock, cannot, therefore, under practical feeding conditions, be due to the presence of sulphur dioxide.

Abstract.

A Sliding Scale for the Convenient Titration of Strong Liquids by Dilution and Use with Aliquot Parts, by C. H. DOUGLAS CLARK, B.Sc., D.I.C., A.I.C.

The device described by the author is a sliding scale designed to assist chemists who are frequently titrating strong solutions against weaker standards by dilution and measurement of a known volume. The scale is easily made, and can be set in different positions, depending on the dilution. It enables the operator to see at once what alternative dilutions are available in any particular case, in order that a convenient burette reading may be obtained at the end of the process, and is designed to assist him in his choice of the most suitable dilution for the purpose required without unnecessary thought or delay.

Abstract.

Some Notes on the Unsaponifiable Matter of Fats, by D. W. STEUART, B.Sc.

In the case of margarines which contain no coconut, palmkernel, or butter fat, it is rather difficult for the analyst to satisfy himself whether he is dealing with a real animal fat margarine, or whether the margarine contains palm oil or hardened vegetable oil. The percentage of sterol in the unsaponifiable matter and the melting point of the sterol acetate have been examined, but these do not yield the information desired. The recognition of polymerised oils and the detection of lecithin are briefly referred to. The proportion of sterol in the unsaponifiable matter varies from 48 per cent. in maize oil to 7 per cent. in palm oil; and from 38 per cent. in lard to 9 per cent. in hardened whale oil. Highly hardened fats still contain sterol.

The cholesterol acetate of animal fats melts at 114 to 114½° C., the phytosterol acetate of vegetable fats is a mixture, a fraction of which melts at 125° C. or above, but some pure vegetable oils yield a fraction melting about 114° C.

Abstract.

Note on the Sulphuric Acid Test for Fish Liver Oils, by NORMAN EVERS, B.Sc., F.I.C., and H. J. FOSTER.

The addition of natural vegetable or animal oils, such as olive, arachis, lard oils, or tallow, which do not themselves give any colour with sulphuric acid, increases the sensitiveness of the test to a remarkable extent. Oxidation of the oils destroys this power but it is unaffected by hydrogenation. The active substance is not cholesterol or phytosterol. It is not present in commercial oleic acid, stearic acid, mono- or di-glycerides. The brown colour produced by sulphuric acid with liver oils after oxidation, is shown to behave in exactly the same manner as the violet colour with the fresh oils, being similarly increased by the addition of natural oils.

THE CHEMICAL SOCIETY.

The Library of the Chemical Society will be closed for the Christmas holidays at 1 p.m. on Friday, December 22nd, and will reopen at 10 a.m. on Thursday, December 28th.

SOCIETY OF GLASS TECHNOLOGY.

A meeting of the Society was held in the Physical Chemistry Theatre, University College, Gower Street, London, W.C.1, on Wednesday, December 13th, 1922, at 2.30 p.m.

AGENDA:

Minutes of meeting held on November 22nd, 1912.

Applications for membership.

A paper entitled *Improvements in the Design of Recuperative Glass Pot Furnaces* was read by T. TEISEN, B.Sc.

General discussion on *The Use of the Autoclave in Testing Glass*. The subject was introduced by the following papers:—

(a) *Some Aspects of the Autoclave Test*, by W. L. BAILLIE.

(b) *Some Criticisms on the Use of the Autoclave as a Method for Testing Glass-ware*, by W. H. WITHEY, B.A.

(c) *Some Difficulties in the Interpretation of Autoclave Results*, by PROF. W. E. S. TURNER, D.Sc., and F. W. HODKIN, B.Sc.

By the courtesy of the University College Authorities, tea was available for members, at the usual charges, in the College Refectory after the meeting.

WORKS EXCURSION.

By the courtesy of the directors, a visit was made to the new Glass Works of Messrs. General Electric Co., Ltd., North Wembley, on Thursday morning, December 14th, 1922.

The plant is engaged in the manufacture of glass tubing. It includes a twelve-pot Hermansen recuperative furnace (each pot having a capacity of 2,500 pounds), two Danner tube making machines, and subsidiary reheating furnaces.

SIR WILLIAM CROOKES'S ANTI-GLARE GLASSES.

By J. H. GARDNER, F.INST.P.

Read at a Meeting of the Optical Society, held at the Imperial Institute of Science and Technology, South Kensington.

Mr. President and Gentlemen,—When a few days ago I was asked on the telephone by your Secretary, Mr. Sutcliffe, to say a few words to-night about Sir William Crookes's Anti-Glare Glasses, I found myself unable to refuse, firstly because the request was made in such a "persuading" way that I had not the heart to say "No." and secondly because I suppose that I have the privilege of knowing as much as anyone about the subject, having been intimately associated with the late Sir William Crookes for more years than I care to count, working under him in all the researches connected with the glasses that bear his name.

Sir William was deeply interested in the subject, and was engaged upon the work at the time of his death.

I have a photograph of Sir William, taken at the time when Anti-Glare Glasses formed the chief topic of discussion at the laboratory.

A few words briefly giving the history of the research may not be out of place.

The work on the radiation transmission of transparent substances began with an enquiry into the cause of Glass-makers' Cataract, and several years of hard work were devoted to it, and in 1914 a paper was read before the Royal Society in which formulæ were given for many glasses having special optical properties, and manufacturers were encouraged to produce them for general use.

As a result, Sir William was inundated with enquiries from private people needing assistance for eyesight trouble, and from manufacturers of glass wishing to use his name for glasses that they had succeeded in making from his published formulæ.

It soon became evident that further work was necessary to produce a glass that would absorb as much Ultra-violet radiation as possible, and at the same time transmit the bulk of the visible rays; the glass also had to be pleasing in appearance.

It was evident that it would be necessary to make a variety of tints to suit different climatic conditions.

The work was carried out with the assistance of Mr. Harry Powell, of Whitefriars Glass Works, whose death unhappily occurred a few days ago.

Agreements were made between Sir William and Mr. Nelson Wingate, of Wigmore Street, W., for the glasses to be placed upon the market as soon as conditions made their production possible.

Some of these glasses are on exhibition here to-night.

Many causes that I need not enter upon now have prevented very large production, but it is hoped that the output will be increased shortly; the glass is of a very special character, and presents unexpected technical difficulties.

On the death of Sir William, the whole of the data for the preparation of the glasses and the apparatus that had been devised for obtaining measurements of the radiation transmitted and absorbed by them were given into my charge, and will shortly be erected at the laboratories of the new Whitefriars Glass Works at Wealdstone, where we hope to be able to produce the material in larger quantities than has been possible at the old works in London.

ON THE PREPARATION OF COLLOIDAL SOLUTIONS OF NICKEL AND COBALT HYDROXIDES AND SOME OTHER COMPOUNDS OF THESE METALS.*

By O. F. TOWER AND MARTHA C. COOKE.

Some years ago one of us, while investigating the tartrates of nickel and cobalt¹ encountered a number of solutions of these substances which were evidently of a colloidal nature. In this paper the results of further investigations of these same substances are described together with some new methods for preparing colloidal solutions of the hydroxides of nickel and cobalt. The former paper should be consulted for a description of the nature and properties of the simple tartrates of these metals and of their double tartrates with potassium. The methods of analysis employed in this work are the same as those there set forth. Dialyzing was carried out either in parchment or collodion bags, which insures rapid diffusion. These were hung in distilled water, which was frequently changed. Parchment seemed to work the best, as the collodion apparently allowed larger particles to pass through, especially in the strongly alkaline solutions.

Simple nickel and cobalt tartrates, when prepared by dissolving the freshly precipitated hydroxides in tartaric acid are not colloids. These solutions are in a state of supersaturation and on standing deposit the crystalline salts. When, however, to these solutions sodium or potassium hydroxide is added a colloidal solution results, and in case solutions as concentrated as "normal" are employed the nickel solution forms a transparent gel. If fifth-normal solutions are used no gel is obtained. The solution is, however, colloidal, as examination by means of the ultramicroscope shows. The gel obtained with the more concentrated solutions after standing several days deposits a light green precipitate of nickel tartrate mixed with variable amounts of potassium tartrate. Whatever may be the nature of the substance in solution,² the precipitate in every case is simply nickel tartrate with more or less potassium tar-

trate adsorbed in it. The dilute solutions which did not gel were subjected to dialysis. In most cases all of the potassium and tartrate radical passed through the membrane leaving colloidal nickel hydroxide inside. Solutions containing at the most 3.2 grams of nickel hydroxide per litre were prepared in this way. The results just described were best obtained when tartaric acid and potassium hydroxide were in molecular proportions, that is, one molecule of the acid (not as free acid, but as nickel tartrate) to one molecule of the hydroxide. If the quantity of hydroxide exceeded this to any great extent, either all of the nickel would diffuse through the membrane also, or some nickel tartrate would precipitate inside the parchment bag as the potassium tartrate diffused out.

Similar solutions containing cobalt acted quite differently; for one reason because cobalt has a tendency to become oxidised to the cobaltic condition in a strongly alkaline solution. If the amount of potassium hydroxide employed was the least possible required to hold cobalt hydroxide in solution,¹ no oxidation seemed to take place. When such a solution was dialyzed one of two results occurred: either light pink cobalt tartrate was precipitated after a day or two inside the bag, or no precipitation at all took place, and after dialyzing several days the contents of the bag consisted of a currant-red gel. Analysis of this gel showed it to be for the most part cobalt tartrate with small quantities of potassium tartrate adsorbed in it. Prolonged shaking of this gel with distilled water failed to peptize it.

In case a greater excess of potassium hydroxide was used in forming these solutions, oxidation would begin at once and the colour would change from pink to purple, to green, and after many days to brown. If solutions as concentrated as "normal" were used, the solutions would set to a gel in about 24 hours (not at once as in the case of the nickel solutions), or about the time the colour began to change. This gel lasted about two weeks, or about the time the colour change was completed, when it gradually passed over into an ordinary solution containing a slimy brown precipitate. More dilute solutions passed through the same changes except that no gel was formed. No attempt was made to dialyze any of the solutions in which co-

* From *Journal of Physical Chemistry*, November, 1922, p. 748.

¹ Tower: *Jour. Am. Chem. Soc.*, 1900, XXII., 501.

² See loc. cit., p. 510.

¹ See loc. cit., p. 517.

balt had obviously become oxidised, as methods of obtaining colloidal solutions of cobaltous hydroxide were being sought.

The literature, as far as we have been able to find, contains but one reference to the preparation of colloidal cobalt hydroxide without the employment of a protective colloid. A. Müller,¹ in 1908, peptized a number of freshly precipitated metallic hydroxides by means of hydrochloric acid or hydrolysed salts of the same metals. In the case of cobalt he used the freshly precipitated hydroxide and hydrochloric acid, and obtained a colloidal solution, which, however, began to deposit a precipitate within 24 hours. Nickel hydroxide is not mentioned.

In addition to the experiments, which have been described to try to obtain colloidal solutions of nickel and cobalt hydroxide by dialyzing solutions of their double tartrates and which resulted successfully only in the case of the former, other methods were also undertaken as follows. Nickel and cobalt hydroxides dissolve in excess of both ammonium hydroxide and carbonate, but as in these cases they form well defined double salts or complex molecules, it was scarcely expected that any colloidal solutions would be produced by subjecting them to dialysis; and such was found to be true. On dialyzing, either the whole of the substance in solution passed through the membrane, or sometimes only the ammoniacal portion, in which latter case the metallic hydroxide or carbonate, as the case might be, was precipitated inside the bag.

One of the best ways of preparing a colloidal solution of nickel hydroxide was discovered accidentally while preparing the hydroxide for conversion into the tartrate. For this purpose a solution of nickel chloride was treated with a little more than the equivalent quantity of a solution of potassium hydroxide, the precipitated nickel hydroxide allowed to settle, the supernatant liquid siphoned off, more water added, and the process repeated several times. It was found that the original concentration of the two solutions mixed was the principal factor in determining how rapidly the nickel hydroxide would settle. If normal solu-

tions were mixed and then diluted afterwards, settling occurred fairly rapidly (say 20 minutes) and all traces of alkali can be washed out in three or four hours. If tenth-normal solutions are mixed, settling takes place much more slowly; and if hundredth-normal solutions are mixed, all day is required for the nickel hydroxide to settle sufficiently so that the supernatant liquid can be drawn off. For the purpose in hand solutions of a concentration about tenth-normal gave the best result. About 500 cc. of each solution were poured together in a tall beaker, thoroughly mixed and set aside to settle. This took about one hour the first time. After siphoning off the solution, about 900 cc. of distilled water was added and thoroughly mixed with the precipitate by pouring back and forth from one beaker to another. Settling took longer this time, and the time increased with each successive washing. After about six such washings during one day, the precipitate was allowed to stand over night with the same quantity of water to settle again, but in the morning the precipitate had vanished and a colloidal solution of nickel hydroxide remained. The solution was somewhat opalescent, exhibited the Tyndall effect, and showed distinct particles under the ultramicroscope.

On different trials the amount of nickel hydroxide thus going into solution varied considerably, for this depends so much on the nature of the precipitate formed when the two original solutions are mixed. If two dilute solutions are employed the precipitate first formed is so finely divided that it is almost impossible to wash it by this method, as it settles too slowly; and unless the potassium chloride is for the most part removed colloidal nickel hydroxide will not form, or at least the sol will not be sufficiently stable to last any length of time. To strike just the right conditions is a matter of some difficulty. In the most successful experiments one litre of solution contained about 1.5 grams of nickel hydroxide.

When such solutions were subjected to dialysis, nickel hydroxide would begin to precipitate within 24 hours, and traces of chloride ions would be found in the dialysate, although the original colloid solution gave a practically negative test for these ions. By estimating the quantity of chlor-

¹ *Zeit. anorg. Chem.*, LVII., 311.

ide ions removed by dialyzing,¹ it was calculated that the solutions contained an equivalent of about 1 cc. tenth-normal potassium chloride in one litre. This seems to show that in order to hold nickel hydroxide in colloidal solution there must be approximately 1 molecule of potassium chloride to 200 molecules of nickel hydroxide. Experiments showed that nickel hydroxide, like other metallic hydroxides, is a positive colloid and gradually drifts toward the negative pole under the influence of a sufficient potential difference. These experiments were carried out in U tubes using a potential difference of 110 volts. The nickel hydroxide is probably stabilised by the potassium ions adsorbed by it. It is well known that other similar colloids adsorb positive ions in this way; but, so far as we know, no colloid is so sensitive to a small change of concentration of these ions as is the nickel hydroxide prepared in the manner just described; for it is precipitated by a slight increase in the concentration of potassium chloride as well as by its removal. Aggregation of the particles in these solutions goes on slowly but continuously, for in the course of six or eight weeks all of the nickel hydroxide precipitates and the solutions become optically empty. The colloidal solutions of nickel hydroxide prepared by dialyzing the double tartrate are more stable, as most of them are perfectly transparent now after standing four months.

Cobalt hydroxide does not pass as readily into colloidal solution when prepared in this manner as does nickel hydroxide, that is, by precipitating from dilute solutions and washing by repeated siphoning off of the supernatant liquid. However, very dilute solutions of a brownish colour can be obtained in this manner. They exhibit the Tyndall effect and show particles under the ultramicroscope, although their concentration in no case exceeded 0.05 gram of cobalt hydroxide per litre. They are also not

very stable, for after standing a few days all of the hydroxide coagulates and precipitates.

Since tartaric acid holds nickel hydroxide in solution, one would expect that glycerine would act similarly. In fact, Chatterji and Dhar¹ state that this is the case, provided the glycerine is added to the solution of the metallic salt before adding sodium hydroxide. We have, however, been unable to confirm this for nickel salts, although we have found it to be true for cobalt salts and the others mentioned by these investigators. Four salts of nickel, the chloride, nitrate, sulphate and acetate, were tried in varying concentrations and with varying quantities of glycerine with both sodium and potassium hydroxides, but with negative results. In a few cases precipitation of nickel hydroxide would be delayed for four or five minutes, but not longer. Nickel acetate dissolves directly in glycerine. If to such a solution an aqueous solution of sodium or potassium hydroxide was added, a precipitate resulted at once. If, however, an alcoholic solution of potassium hydroxide was employed, no precipitation occurred, and in a few minutes the whole mixture set to a gel. These were the only conditions under which we found that glycerine would hold nickel hydroxide in solution. If this gel was diluted with water or with 90 per cent. alcohol, nickel hydroxide was thrown down immediately by the water and after a few minutes' delay by the alcohol. On standing, this gel underwent some interesting changes. After standing about 24 hours it clouded up and became opaque. It continued in this state for 10 or 12 days, after which syneresis began. The liquid portion rapidly increased in amount and in a few days entirely peptized the solid portion, so that a limpid green solution remained. Dilution with water now caused no precipitation, although the solution was distinctly alkaline. A portion of this dilute solution was then placed in a collodion tube and dialyzed. In three or four days the contents of the tube had gelled. The gel consisted of nickel hydroxide with some organic matter in it. The excess of alkali had dialyzed out. A second portion of the diluted solution standing without dialyzing for the same length of time did not gel. It of course still contained excess of potassium hydroxide.

¹ This was accomplished by comparing the cloudiness obtained by adding tenth-normal silver nitrate to 500 cc. of the dialysate with that obtained from standards prepared by treating 500 cc. of solutions containing known amounts of potassium chloride with tenth-normal silver nitrate. This method could not be used with the original colloidal solution because of its greenish colour and slight opalescence.

¹ *Trans. Faraday Society*, Vol. 16, appendix to Part 3.

It might be stated, in closing, that both colloidal nickel and cobalt hydroxides are reported to have been prepared by Paal's method,¹ that is, by employing certain protein decomposition products as protective colloids. Our experiments have, however, been limited to attempts to prepare such solutions without the aid of protective colloids.

It is well known that nickel sulphide is readily held in colloidal solution in the presence of a large excess of alkali, especially if an organic substance like tartaric acid or glycerine is present.² We have found that if such solutions are dialyzed the nickel sulphide is completely precipitated and the remaining liquid is optically empty. The tartrates, glycerine and excess of alkali pass through the dialyzing membrane, and their stabilising effect is evidently required to keep nickel sulphide in the colloidal state.

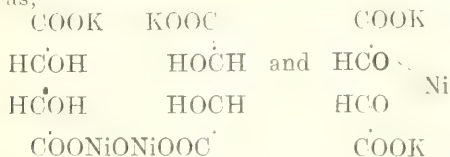
The conclusions of this paper may be thus summarised:

1. Two methods are described for preparing colloidal solutions of nickel hydroxide, one by dialyzing a solution of nickel tartrate in the presence of an alkaline solution of potassium tartrate, and the other by a special method of precipitating and washing the hydroxide itself.

2. Cobalt(ous) hydroxide does not pass readily into colloidal solution by these methods; only very dilute solutions of it could be obtained.

3. The tartrates of nickel and cobalt in the presence of an excess of alkali exist in the colloidal state.

4. In a former paper evidence was presented for the existence in solution of such salts as,



but since we have here to deal with solutions of colloids that evidence is of little value. Any solids obtained from such solutions appear to be only nickel tartrate with more or less potassium tartrate adsorbed in it.

5. Glycerine does not prevent the precipitation of nickel hydroxide from aqueous solutions. In alcoholic solution interest-

ing transformations occur, and a solution is eventually obtained from which nickel hydroxide cannot be precipitated by diluting with water.

6. Colloidal solutions of nickel sulphide, which are readily formed in the presence of an alkaline solution of a tartrate, immediately decompose with precipitation of the sulphide on dialyzing out the tartrate.

*The Morley Chemical Laboratory,
Western Reserve University,
June, 1922.*

OBITUARY.

We regret to record the death of Mr. Harry Powell, O.B.E., on Sunday, the 26th of November. Mr. Powell was for 46 years manager of the Whitefriars Glass Works, which he joined in 1873, and from then until 1919, when he retired, his whole energies were devoted to the advancement of British glass craftsmanship. Under his direction glassware of the highest quality and unique design has been produced in the factory of Whitefriars. This factory was built on the site of the Carmelite Monastery, and has been used as a glasshouse for the last 250 years. Mr. Powell did more than anyone to maintain the high standard of British glassware, and many examples of his work are now in the South Kensington Museum. During the war he rendered important service by the production of glass tube that was used in large quantities for the projecting horns of marine mines.

Mr. Powell devoted a deal of his time to education, and had for many years been chairman of James Allen's Girls' School, East Dulwich; he was also a governor of Dulwich College.

We have received a copy of the Christmas number of *Work*. The issue, which consists of forty pages, is fully illustrated and gives details on many matters which are specially useful at this time of the year. Here are a few of the subjects which are typical of the contents as a whole: "Making Up for Amateur Theatricals"; "Making Christmas Cards at Home"; "Home Decorations and Illuminations"; "Some New Conjuring Tricks for Amateurs"; "Amateur Wireless at Home"; "Parlour Tricks for Christmas Parties"; "Easily made Chinese Lanterns," and "Preparing for the Christmas Party: The Parlour Stage and its Arrangements."

¹ German patent (1906), described in Svedberg's "Herstellung kolloider Lösungen," p. 327.

² Loc. cit., p. 518.

A NEW METHOD FOR THE GRAVIMETRIC DETERMINATION OF GERMANIUM.*

[CONTRIBUTION FROM THE JOHN HARRISON LABORATORY OF CHEMISTRY OF THE UNIVERSITY OF PENNSYLVANIA.]

By John Hughes Müller.

Analytical procedure for the quantitative determination of germanium has not changed since the early investigations of Winkler¹ immediately following his discovery of the element in 1886; that is to say, germanium has always been weighed as sulphide or dioxide and no other compound has been reported which admits of direct application to quantitative estimation.

Weighing of the disulphide yields excellent results, but is usually avoided on account of the required washing for the removal of free sulphur, as well as the inability of this salt to withstand ordinary ignition. In consequence, the sulphide is nearly always converted to dioxide by frequent evaporation with nitric acid and ignition to constant weight.

In many determinations it has been the writer's experience that the conversion of sulphide to oxide, aside from being time consuming, is subject to serious conflicting errors. First, the sulphide is violently attacked by even dil. nitric acid and yet must be thoroughly decomposed by this acid before much heat is applied to the residue. Second, after complete oxidation, the removal of all of the sulphuric acid is very difficult, if indeed possible.

A slight loss of germanium through volatility of the unoxidized sulphide plus the mechanical loss in the escaping oxides of nitrogen tends to give low results, but on the other hand the tightly held sulphuric acid which clings to the ignited residue causes error in the other direction. These conflicting or balancing errors are practically beyond control of the analyst, and have suggested to the writer the search for an altogether different method for the estimation of germanium.

The purpose of this communication is to describe a new method for the gravimetric determination of germanium, which is based upon the action of magnesia mixture upon solutions of germanic oxide in the presence of free ammonia.

It will be shown that, under proper conditions, the precipitate consists entirely of magnesium orthogermanate (Mg_2GeO_4), which hitherto unreported compound appears to possess all of the properties required for its use in this connection.

REAGENTS AND APPARATUS.

The following reagents were employed throughout this work. A normal solution of magnesium sulphate, free from silica, iron, calcium. A 2N solution of ammonium sulphate, free from heavy metals and alkaline earths; ignition of a 5g. sample gave an inappreciable non-volatile residue.

Ammonium hydroxide, sp. gr. 0.89; this was freshly prepared by distillation from platinum and was preserved in vessels of the same material.

Hydrogen peroxide, a 30 per cent. solution, free from phosphoric acid and other non-volatile matter.

Germanic acid in aqueous solutions of different concentrations. The stock solution from which the other more dilute solutions were prepared contained 0.004308 g. of GeO_2 per cc. at 26°. These solutions were restandardised separately by evaporation of 50 cc. samples and ignition of residual oxide to constant weight. The germanium dioxide was of the highest degree of purity and entirely free from arsenic.

Ordinary distilled water, freshly prepared, was used. The flasks and pipettes were calibrated at 26°; the balance was a Troemner No. 10, with a sensibility of 0.00002 g.; the weights were recalibrated. Porcelain crucibles and Pyrex glassware were used throughout. All precipitates were collected upon ashless filter paper upon which the operation of drying and ignition was performed without disturbing the mass of precipitate.

PRELIMINARY EXPERIMENTAL WORK.

One hundred cc. of an aqueous solution of germanic acid containing 0.4308 g. of germanium dioxide was treated with 25 cc. of N magnesium sulphate solution and 15 cc. of 2 N ammonium sulphate solution.

Upon addition of 20 cc. of conc. ammonium hydroxide, a bulky white precipitate immediately formed. The mixture was raised to boiling, allowed to cool and to stand for 12 hours. The filtrate and wash water were separately collected and examined for germanium as follows. Each was neutralised and then made approximately 6 N with sulphuric acid. The acid solutions were now saturated with hydrogen sulphide in the cold. Only a slight tur-

¹ Winkler, *J. prakt. Chem.*, 1886, [2] XXXIV., 177; 1887, XXXVI., 177.

bidity appeared in about an hour. In 24 hours each solution contained a small precipitate, which was converted to oxide in the usual way and weighed. The filtrate, measuring 140 cc., contained 0.0002 g. of germanium dioxide. The wash water, which was originally slightly ammoniacal, contained 0.0004 g. of germanium dioxide in 50 cc. This procedure was repeated several times and in no case was more than 0.0005 g. of germanium dioxide found in the combined filtrate and wash water.

Precipitation of the same quantity of germanium was carried out in the presence of a much larger excess of ammonium salt. The filtrate then contained an appreciable quantity of unprecipitated germanium, even after several days' standing. For example, 100 cc. of germanic acid solution treated with 50 cc. of 2 N ammonium sulphate solution, 20 cc. of N magnesium sulphate solution, and 20 cc. of ammonium hydroxide gave a filtrate containing 0.00012 g. of germanium dioxide, although the solution was allowed to stand for several days before filtration.

A number of attempts to precipitate magnesium germanate completely with less than 5 or 6 hours' digestion in presence of the precipitant failed.

Elevation of the temperature to boiling point increases the rapidity of the precipitation and improves the condition of the precipitate for filtration and washing.

The chlorides of magnesium and ammonium cannot be substituted for the sulphates in the precipitation of magnesium germanate, because a small amount of ammonium chloride, invariably brought down with the magnesium salt, causes loss of germanium upon subsequent ignition of the precipitate, due to the volatility of germanium chloride.

COMPOSITION AND GENERAL PROPERTIES OF THE PRECIPITATE.

The precipitates obtained in the above preliminary experiments were collected and analysed as follows.

After ignition to constant weight by aid of a Meker burner and a blast lamp, the snow-white infusible mass was dissolved in a little dil. sulphuric acid, diluted to 50 cc. and then made approximately 6 N by addition of the measured quantity of conc. sulphuric acid. The acid solution was then saturated with hydrogen sulphide under pressure, and the germanium sulphide was converted to the dioxide in the usual manner and weighed. The magnesium content of the filtrate from the ger-

manium sulphide was determined by the usual magnesium pyrophosphate method. The following table shows the results of four analyses of the magnesium salt:

TABLE I.

<i>Analysis of Magnesium Orthogermanate.</i>		
Wt. of salt taken, (GeO ₂ found, MgO found.		
g.	%	%
0.1186	56.72	43.17
0.2025	56.65	43.47
0.1348	56.30	43.20
0.3823	56.20	43.82
	Mean 56.47	Mean 43.42

From these results it may be seen that the salt precipitated from an aqueous solution of germanic acid by ammonia mixture is magnesium orthogermanate. Theoretically, this salt contains 56.45 per cent. germanium dioxide and 43.55 per cent. magnesium, which values are very close to the means obtained.

Magnesium orthogermanate is a pure white, amorphous substance which shows no definite crystalline structure under microscopic examination. It is infusible at the highest temperature obtainable in the blast lamp, and is non-volatile at a white heat. A large excess of ammonium salts retards its formation, but does not prevent quantitative precipitation unless present in greater concentration than that equivalent to 25 cc. of 2 N ammonium salt to each 100 cc. of germanic acid solution. The precipitate is very soluble in dilute solutions of all the mineral acids and is only slowly soluble in the same acids even after intense ignition. If the excess of ammonia be boiled off, the precipitate will pass into solution in the nearly neutral ammonium salt. Reprecipitation takes place upon addition of more ammonia.

SOLUBILITY OF MAGNESIUM ORTHO-GERMANATE.

An excess of the thoroughly washed salt was suspended in pure redistilled water in a platinum bottle in which it was allowed to remain for several weeks at 26°. The vessel was frequently shaken. After filtration through a dry filter, 25 cc. of the filtrate was evaporated to dryness and ignited in platinum. The residue of magnesium salt weighed 0.0004 g., representing a solubility of 0.000016 g. per cc. at this temperature.

The same procedure was carried out using 3 volumes of water and 2 volumes of ammonium hydroxide in place of the pure water. The solubility was only slightly different, 1 cc. containing 0.00002 g.

Another portion of the magnesium salt, suspended in a 10 per cent. ammonium sulphate solution rendered strongly alkaline with ammonia, and digested at room temperature for a week, showed upon filtration, evaporation and ignition of a 20 cc. sample, a solubility of 0.00013 g. per cc.

It is evident that magnesium germanate is about ten times as soluble in dil. aqueous ammonia containing 10 per cent. ammonium sulphate, as in pure water or dil. aqueous ammonia. The presence of an excess of magnesium ion, however, reduces this solvent action of the ammonium salt well within the limits required for a quantitative precipitation.

No advantage is obtained by addition of much ammonia to the wash water, as the precipitated magnesium salt shows nearly the same solubility in both water and dil. aqueous ammonia. In all of the described determinations the wash water contained 10 cc. of ammonium hydroxide sp. gr. 0.89, to 90 cc. of water.

FINAL DETERMINATIONS.

In all of the final determinations which follow in tabular form, the germanic acid solutions were treated with the normal magnesium sulphate solution in excess, followed by at least an equal volume of 2 N ammonium sulphate solution. The ammonium hydroxide was always added last in amounts varying from 15 to 20 cc., for each 100 cc. of solution, while the solution was stirred vigorously, and the whole then raised to boiling for a few moments and allowed to cool and stand for 10 to 12 hours before it was filtered. The wash water, a mixture of 90 cc. of water and 10 cc. of ammonium hydroxide (sp. gr. 0.89) varied in volume with the quantity of precipitate, but did not exceed 50 cc. in any instance. Ash-free paper filters were used in every case, except Analyses 1 and 2, in which the bulky mass of precipitate was collected upon porcelain Gooch crucibles with asbestos mats. It was not necessary to remove precipitates from the filter paper. The precipitates were quickly dried and ignited with free access to air. Very little reduction takes place by action of the filter paper, and the slightly darkened surface of the ignited mass, produced by action of the carbon, rapidly oxidizes to the pure white germanate upon continued ignition. Toward the end of each ignition the precipitate was heated over a blast lamp to constant weight.

Magnesium germanate may be ignited in platinum, if care be taken to avoid reduc-

ing gases. The presence of filter paper, however, makes this procedure rather unsafe.

Analytically, germanium is invariably met with as sulphide, but the determination as magnesium orthogermanate requires an ammoniacal solution of the oxide. The simplest method of treatment of the precipitated sulphide consists in the addition of a slight excess of ammonium hydroxide, followed by an excess of hydrogen peroxide. Upon boiling, to destroy the excess of peroxide, the solution contains ammonium germanate and is ready for precipitation as the magnesium salt in the way described. It is scarcely necessary to remark that ordinary hydrogen peroxide often contains phosphoric acid, and that such an impurity must be absent from the reagent used for this precipitation. Furthermore, hydrogen peroxide prevents the precipitation of magnesium germanate, so that it is essential that the excess of peroxide used to oxidize the ammonium thiogermanate be destroyed by long boiling before the precipitation of the magnesium salt.

When arsenic accompanies germanium the 2 sulphides may be separated through the solubility of germanium sulphide in hydrofluoric acid.² The solution of germanium fluoride, obtained by filtration, can then be evaporated with a little sulphuric acid to expel the hydrofluoric acid, and may then be treated with magnesium sulphate and an excess of ammonium hydroxide. The presence of fluorides entirely prevents the precipitation of magnesium germanate.

It is necessary to lay emphasis upon the importance of controlling the concentration of the reagents used in the precipitation of magnesium germanate. For quantities of germanium dioxide varying between 0.5 and 0.2 g. in 100 cc. of solution, it was found best to add from 20 to 25 cc. of 2 N ammonium sulphate solution, together with the excess of magnesium salt (15 to 25 cc. of N solution). In a series of preliminary experiments it was found that lower concentrations of the ammonium salt resulted in the complete precipitation of the germanium content of the solution, but the analysis of the precipitate showed too high a content of magnesia, to correspond with the formula of the normal salt. On the other hand, a large excess of ammonium

² Müller, *Jour. Amer. Chem. Soc.*, 1921, **IVIII**, 2549.

salt retards the precipitation to an unnecessary degree.

Obviously, two methods of procedure can be used to prevent this source of error: (1) add the proper excess of ammonium sulphate in quantity sufficient to prevent the separation of magnesia; (2) resort to a double precipitation of the magnesium germanate similar to that commonly carried

out in the quantitative estimation of magnesium pyrophosphate or arsenate; that is to say, the moist precipitate of magnesium germanate may be dissolved in dil. sulphuric acid and the solution then treated with excess of ammonia, the whole raised to boiling temperature and then allowed to cool before a slight excess of magnesium sulphate is added to complete the precipitation of the germanate.

TABLE II.
Final Determinations.

GeO ₂ taken g.	Mg.GeO ₃ found g.	GeO ₂ calculated from Mg salt g.	Vol. of soln. cc.	GeO ₂ found in filtrate g.
0.4308	0.7623	0.4391	135	0.0006
0.2154	0.3823	0.2158	110	0.0002
0.0135	0.0248	0.0139	75	0.0004
0.0135	0.0244	0.0137	75	trace
0.1130	0.2036	0.1148	100	0.0006
0.0006	0.0013	0.0007	40	trace
0.0013	0.0027	0.0015	25	trace
0.0005	0.0011	0.0006	30	none
0.0011	0.0018	0.0010	50	none
0.0002	0.0003	0.0001	15	trace

The final results, Table II., show that the simpler method involving a single precipitation, allows the fairly accurate determination of germanium with the escape of almost negligible amounts of germanium in the filtrate and wash water. In the method of double precipitation, results were not obtained which were in any way superior to or more concordant than those resulting from a single precipitation in the presence of the above-mentioned excess of ammonium sulphate.

SUMMARY AND CONCLUSION.

1. Magnesium orthogermanate, a compound not hitherto reported, has been prepared and its general properties described.

2. This salt is admirably adapted to the gravimetric determination of germanium in

quantities ranging between 0.5 g. and 0.0002 g. The precipitation and ignition of this compound are not accompanied by change in composition or any loss by volatility.

3. Ordinary quantitative filter paper may be used and the precipitate quickly dried and ignited to constant weight.

4. The described method is considerably simpler than that of the determination as sulphide, and, the writer believes, more accurate than the well-known conversion of the disulphide to dioxide.

Philadelphia, Pennsylvania.

* From the *Journal of the American Chemical Society*, November, 1922, p. 2493.

NOTICES OF BOOKS.

Joannes Baptista van Helmont: Alchemist, Physician and Philosopher. By H. STANLEY REDGROVE, B.Sc., F.C.S., and I. M. L. REDGROVE. Pp. 86 + 1 plate. London: Messrs. William Rider & Sons, Ltd., 8-11, Paternoster Row, E.C.4. Price 2s. net.

The annals of Chemistry contain, prior to the eighteenth century, no name greater than that of Joannes Baptista van Helmont. It is surprising, therefore, that, apart from paragraphs to be found concerning him in histories of chemistry and other

works of reference, no account of his life and work has hitherto appeared in English. Mr. Redgrove, as proved by his previous contributions to the history of chemistry, is undoubtedly better equipped for dealing with the subject of van Helmont than any other living writer; he has certainly not disappointed us, and in fact the book needs no other recommendation than to say that it is from his pen. As in the case of his previous life of Joseph Glanvill, recently reviewed in these columns, in writing this book he has had the able assistance of his wife.

Although the book is a small one, and consequently very cheap, it contains all that it is necessary for us to know concerning the life and works of the man with whom it deals; and in fact it is remarkable how much information the authors, by the avoidance of every unnecessary word, have managed to pack into so small a compass. It should be noted with approval, moreover, that full references to the original sources of information—which are, in the main, van Helmont's own writings—are given for every statement.

The book is divided into six chapters. The first chapter, which is in the nature of an introduction, briefly surveys the work of Paracelsus, whose disciple van Helmont, to a limited extent, was, and supplies the necessary historical background for what follows. Chapters 2 and 3 are biographical; and the authors well describe van Helmont's life as showing us "the conflict of light with darkness of free enquiry with tradition, of truth with dogmatism, of love with hate." Chapter 4, under the title of "Mysticism and Magic," deals with van Helmont's philosophical notions, and it is well pointed out how, in spite of much that seems fantastic, many of van Helmont's philosophical ideas are evidence of an energetic mind and show certain approximations to current thought. Chapter 5 deals with his work as a chemist. His invention of the word "gas," his investigation of *gas sylvestre* (carbon dioxide) and other gases, his researches on silica and other experiments in which he came, as the writers say, "within an ace of realising not only the true nature of a chemical element . . . but also the law of its persistence," his views concerning the First Matter, which, although erroneous, led to some very interesting experiments, and finally his experiments in transmutation are all adequately dealt with. Van Helmont's account of how he effected the transmutation of mercury into gold by the aid of an unknown powder is amongst the most remarkable in all alchemical literature. The writers point out the difficulties of either explaining this story, or explaining it away, and wisely refrain from any note of dogmatism. The final chapter deals with van Helmont's medical theories, and reviews at some length his contributions, which were considerable, and in many cases of much value, to physiology, pathology, and therapeutics. J.G.F.D.



This list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 31248—Goldschmidt Akt. Ges., T.—Production of amorphous finely-subdivided litharge. Nov. 15.
- 31254—Imray, O. Y.—Manufacture of azo dyestuffs. Nov. 15.
- 30933—Jacobson, B. H.—Manufacture of aluminium chloride. Nov. 13.
- 31257—Perim, H.—Process for manufacturing dioxuperylene. Nov. 15.
- 31211—Spence, H.—Production of aluminous compounds. Nov. 15.
- 31977—Becco Engineering & Chemical Co.—Treatment of waters containing alkaline bicarbonates. Nov. 22.
- 32080—Bloxam, A. G.—Manufacture of azo dyestuffs. Nov. 23.
- 31877—Braithwaite & Co.—Crystallization of matter in solution from liquids. Nov. 22.
- 31485—Edwards, G. W.—Treatment of oxidized ores. Nov. 20.
- 32134—Nicholson, T.—Neutralizing ammonium sulphate. Nov. 24.
- 31791—Wagner, W. G.—Extraction of metals from their ores. Nov. 21.

Specifications Published this Week.

- 188045—Goss, H. W.—Apparatus for chlorinating water or other liquid.
- 169962—Melamid, Dr. M.—Process for the manufacture of substances of the fatty-acid type.
- 171970—L'Air Liquide Soc. G. Claude.—Synthesis of ammonia.
- 188558—Richowsky, F.—Processes of producing titanium nitrogen compounds.

Abstract Published this Week.

B-Thionaphthisatin.—Patent No. 186859. — The Soc. of Chemical Industry of Basle, Switzerland, has obtained a Patent in this country for a process for preparing B-thionaphthisatin.

The product is obtained by the reaction of oxalyl chloride on B-thionaphthol in the presence or absence of diluents or condensing-agents. According to the examples, B-thionaphthol is boiled with excess of oxalyl chloride, boiled with oxalyl chloride in carbon bisulphide solution, with or without further treatment with aluminium chloride, or treated in the cold with oxalyl chloride in the presence of concentrated sulphuric acid.

Messrs. Rayner & Co. will obtain printed copies of the published Specifications, and forward on post free for the official price of 1s. each.

THE CHEMICAL NEWS,

VOL. CXXV., No. 3722.

APPEAL FOR MEDICAL AID FOR RUSSIA FROM DR. NANSEN'S COMMITTEE.

TO THE SCIENTISTS AND MEDICAL MEN OF
THE WORLD.

Following on the Great War, the Civil War, and the long blockade, Russia has passed through a famine the like of which has not been known for centuries. One-third of the vast area of Russia is affected by the famine, a population of thirty-five million is stricken, and death has carried away millions of victims. Famine has wiped out both rural and urban populations; the peasants—the producers of grain for the world market—have died; whole nations, inhabiting the stricken regions, have vanished, and children, the hope of the future, have died out elsewhere. The horrors of famine have driven the inhabitants to fly, leaving their homes, deserting their cattle and fields. Whole villages have been ruined, the households left without furniture and without cattle. Factories are idle; the number of unemployed is growing, thousands of children have been left homeless.

Russian medical personnel, being cut off from the rest of the world in remote villages and townlets, amidst thousands of sick and starving people, has been quite helpless in this great calamity; yet they have heroically borne their burden and carried out their duty, despite the imminent danger of death. Infirmaries, and in particular Emergency Medical Treatment centres, organised with great effort, have had to be closed down owing to the lack of drugs and medical stores, and thus the struggle with the effects of famine is left entirely to the Russian medical personnel themselves. The exhausted and weak population of the affected regions fall easy victims to all kinds of epidemics which threaten not only Russia but the whole of Europe.

The lives not only of the present generation, but of those of the future, are in danger.

The necessity of immediate and energetic aid is imperative. But Russia by herself is powerless.

We therefore appeal in the name of humanity and international solidarity, to the Scientific World of Europe and

America, and we are sure that our appeal will meet with a generous response from the scientists and medical men of the world.

The sanitary and biological effects of the famine will be felt for a long time to come, and not only in Russia, but in Europe as well. The Russian famine confronts the Scientific World as an exceptional sanitary and biological problem, for the solution of which all the forces of science and medicine need to be concentrated.

And how should this assistance be given?

In every country, in each division of the country, and in all the larger centres, a Committee of Medical Relief to fight the effects of the famine in Russia should now be organised.

All the medical committees should be united in an International Committee for medical aid to fight the effects of the famine in Russia, under the presidency of Dr. Nansen.

The programme of the work of the international fight against the consequences of the famine must comprise:—

- (1) A well-directed agitation for the recognition of the Russian famine as an international sanitary and biological calamity.
- (2) Appeals to Governments.
- (3) To the people of the different countries.
- (4) Appeals to the scientific and medical workers of the whole world.
- (5) The collection of money.
- (6) The organisation of help in the way of medical equipment, medicines, and sanitary articles, and means for organising medical institutions in the affected areas; as well as
- (7) the scientific study of famine from the sanitary and biological aspect.

The principle of international scientific and medical solidarity was a fairly well established achievement of the pre-war period. Now, after the terrible world war, which has led to a number of grave social catastrophes and calamities, including the Russian famine, that solidarity must come again into active existence.

Contributions in money should be sent to Treasurer, Medical Aid Committee, London Joint City & Midland Bank, 6, Chancery Lane, W.C.2. They will be acknowledged by the Bank.

Contributions in kind should be sent to Secretary, Medical Aid Committee, 68, Lincoln's Inn Fields, W.C.2, and will be acknowledged by the Secretary.

MISSING ELEMENTS IN THE PERIODIC TABLE.

(PART II.).

By F. H. Loring.

In this Journal of Nov. 24th (vol. CXXV., p. 309) the above subject was discussed, and certain conclusions were arrived at, but further information on the subject seems desirable in order to strengthen the deductions so far made.

In this extension of the original paper, a new study by two American authorities is introduced, and this may be of general interest. The Periodic Table herein developed, which is based upon the previous one given, may be considered from the chemical as well as from the physical side.

Recapitulating, in particular it was shown that the exceedingly small quantities of scandium relative to the quantities of those elements on either side of it made it possible to formulate a "series" which seems to indicate that certain elements either do not exist, or if they do, the quantities to be discovered are exceedingly minute.

Now F. W. Clarke and H. S. Washington, of the United States Geological Survey, have made an investigation of the average percentage composition of the earth's crust down to radial depths of 10 and 20 miles, and of course the term *crust* may be taken, where the context admits, to include the atmosphere and the waters of the oceans and seas.

These investigators, on analysing over 5,100 samples, found a great preponderance of oxygen, silicon, aluminium, iron, calcium, sodium, potassium, and magnesium over the other elements present. To give expression to their findings, as thus far recorded (further publication is to be expected), use will be here made of the data given in an article by T. Crook, which appeared in *Nature* of August 19, 1922 (p. 253). To this end, Table IV. herewith is given, which agrees with Crook's table except that the extreme decimal fractions above barium are rounded off to the nearest figure, so as to reduce the labour in setting up the type, for the evaluations are sufficiently approximate to justify so doing.

In this Table, Column I. is the average composition of a ten-mile crust comprising the atmosphere and hydrosphere; Column II. is similarly the average composition of a twenty-mile crust comprising the atmosphere and hydrosphere; Column III. is

the average composition of a ten-mile crust of igneous and sedimentary rocks; while Column IV. is the average composition of ten miles of igneous rocks. For further particulars, see Crook's article, and the original paper which appeared in the *Proceedings of the National Academy of Science*, 1922, vol. VIII., p. 108.

TABLE IV.

Element	I.	II.	III.	IV.
Oxygen ...	49.2	47.8	46.7	46.4
Silicon ...	25.7	26.7	27.6	27.6
Alu- minium	7.5	7.8	8.0	8.1
Iron	4.7	4.9	5.0	5.1
Calcium ..	3.4	3.5	3.6	3.6
Sodium ..	2.6	2.7	2.7	2.8
Potassium	2.4	2.5	2.6	2.6
Magne- sium	2.0	2.0	2.1	2.1
Hydro- gen	0.88	0.50	0.14	0.13
Titanium .	0.65	0.68	0.70	0.72
Chlorine .	0.23	0.16	0.10	0.10
Phos- phorus	0.14	0.15	0.15	0.16
Carbon ...	0.14	0.10	0.15	0.05
Manganese	0.11	0.12	0.12	0.12
Sulphur ..	0.10	0.09	0.10	0.08
Barium ...	0.075	0.078	0.079	0.081
Chromium	0.062	0.065	0.066	0.068
Zirconium	0.048	0.050	0.052	0.052
Vanadium	0.038	0.040	0.041	0.041
Strontium	0.032	0.034	0.034	0.034
Fluorine ..	0.030	0.030	0.030	0.030
Nickel	0.030	0.031	0.031	0.031
Nitrogen .	0.030	0.016		
Cerium, Yttrium	0.019	0.020	0.020	0.020
Copper ...	0.010	0.010	0.010	0.010
Lithium ..	0.005	0.005	0.005	0.005
Zinc	0.004	0.004	0.004	0.004
Cobalt	0.003	0.003	0.003	0.003
Lead	0.002	0.002	0.002	0.002
Boron ...	0.001	0.001	0.001	0.001
Beryllium	0.001	0.001	0.001	0.001

About .. 100% 100% 100% 100%

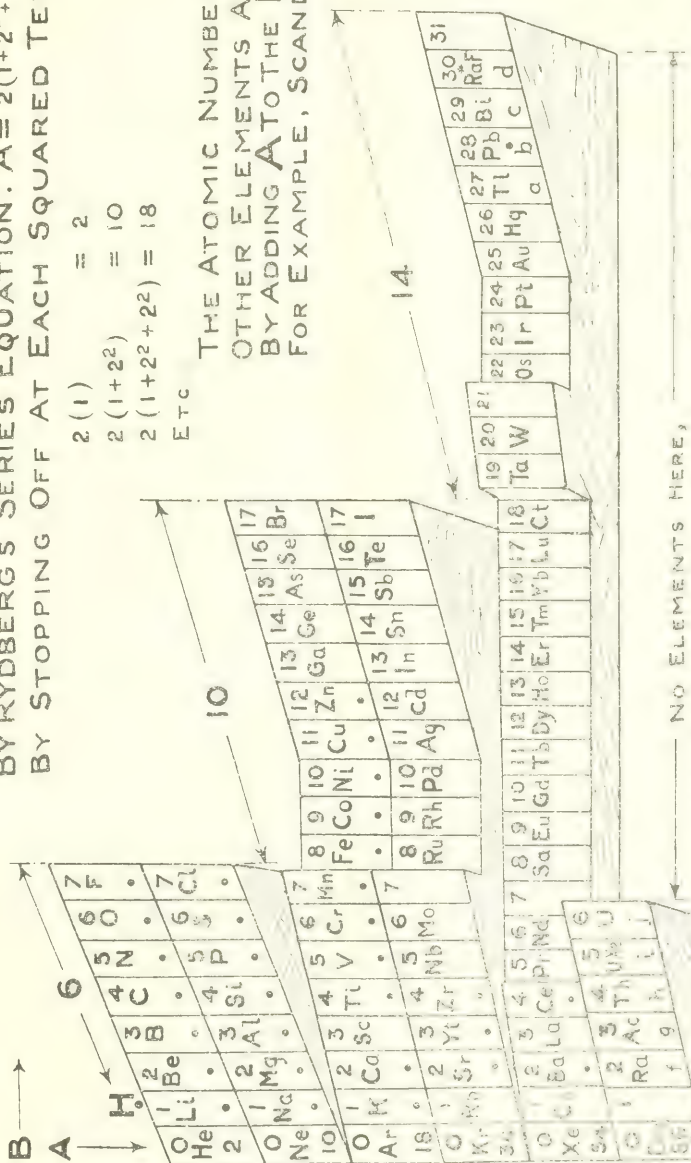
Crook comments on the above results as follows: "A serious defect in the method of procedure on which the above estimates by Clarke and Washington are based is that it makes no allowance for the relative magnitude of the different kinds of rock of which the lithosphere is composed. They admit this defect, but claim that any errors involved are likely to be compensating (*Journ. Franklin Inst.*, 1920, vol.

THE WEDGE PERIODIC TABLE OF THE ELEMENTS (BASED ON ATOMIC NUMBERS AND ATOMIC LEVELS)

THE ATOMIC NUMBER OF THE INERT GASES **A** IS GIVEN BY RYDBERG'S SERIES EQUATION. $A = 2(1+2^2+3^2+4^2 \dots)$, BY STOPPING OFF AT EACH SQUARED TERM THUS—

$$\begin{aligned} 2(1) &= 2 \\ 2(1+2^2) &= 10 \\ 2(1+2^2+3^2) &= 18 \\ &\text{ETC} \end{aligned}$$

THE ATOMIC NUMBERS OF ALL THE OTHER ELEMENTS ARE OBTAINED BY ADDING **A** TO THE **B** NUMBERS. FOR EXAMPLE, SCANDIUM IS $3+18=21$.



NO ELEMENTS HERE,

AND EXCEEDINGLY SMALL QUANTITIES OF ELEMENTS, OR IN SOME CASES NONE, WILL OCCUPY PLACES BEARING ATOMIC NUMBERS, 21, 43, 61, 75, 85, 91, 93; FOR THESE NUMBERS GIVE DIFFERENCES OF A LIMITING SERIES

THUS—

THE SMALL QUANTITIES OF SCANDIUM AND URANIUM $\times 2$ RELATIVE TO THE RESPECTIVE QUANTITIES OF OTHER ELEMENTS ON EACH SIDE OF THEM GIVE SUPPORT TO THIS VIEW.

THE RADIO-ELEMENTS FIT INTO PLACES **A**, **B**, **C**, ETC., AS ISOTOPES OR THOSE INSERTED TO CHARACTERISE THE PLACES. EMS. = EMANATIONS. ATOMIC NUMBER OF H = 1

THOSE ELEMENTS OCCURRING IN GREATER ABUNDANCE ON THE EARTH ARE INDICATED BY A BLACK SPOT

* OR POLONIUM Po

CXC., p. 770).'' However this may be, the percentages given can no doubt be taken as an approximation to the truth in many cases.

It will be seen from this table that there is roughly almost as much calcium as iron in the earth's crust. Similarly, there is more titanium than hydrogen. These two elements (Ca and Ti) fall next to scandium, so that in all probability the statement that scandium is present in *relatively* small quantities is justified.

Reference was made in the original paper, by the present writer, to a Wedge Type of Periodic Table. This Table (V.) is here produced in a complete form with accompanying explanatory data; and the elements of Table IV. are indicated thereon by black spots, so that those which are more abundant may be seen at a glance.

In studying the relations shown, it will be seen that the position of hydrogen is fixed by the concurrence of three significant differences, as given in the series underneath the Table. This observation by itself would not have sufficient weight to become a determining factor, since it might be a chance coincidence, but when further factors are taken into account (see my "Atomic Theories," chapter XX., p. 151), the position of hydrogen over lithium appears to be in many respects a satisfactory one, though the artificiality of all classifications must be kept in mind. Nature did not evolve the elements to fit a given preconceived periodic table. The periodic scheme is man's epitome of the resultant effect of the working of various laws or forces in which *periodicity of action* seems prominent, and its constructional artificiality is apparent in the sense intended.

TABLE V.

The term, *Atomic Level*, should not be confused with the level often referred to in analysing the electron rings or shells of the atoms by means of X-rays; for the K, L, M, N series of lines are supposed to originate respectively in, or in connection with, different energy levels. There may be a relationship between these two ideas (they may be two aspects of one and the same thing), but until such a relationship is clearly established it is better to treat them as different factors in atomic physics. The "levels" given in the present Table (V.) are not intended to be final as regards adjustment, as this would entail a very thorough study of the chemical properties

of *some* of the elements of the rare-earth series about which very little is known.

SUMMARY.

The relative distribution of elements in the earth's crust, according to the findings of Clarke and Washington, is tabulated and shown to support the view that scandium exists in relatively small quantities compared with the quantities of Ca and Ti situated on each side of it in the periodic table, and this fact strengthens the conception of a significant atomic-number series, thereby earmarking the periodic places where no elements can fall, or if they do fall into such places the quantities will be exceedingly minute. The wedge type of periodic table involving atomic levels as well as atomic numbers is illustrated by a perspective drawing. In this connection, the position of hydrogen over lithium is fixed by the coincidence in two number-sequences shown in the Tables.

November 29th, 1922.

ROYAL INSTITUTION OF GREAT BRITAIN.

WEEKLY EVENING MEETING, FRIDAY, APRIL 28, 1922.

Sir James Reid, Bart, G.C.V.O., K.C.B., M.D., LL.D., Vice-President, in the Chair

ARTHUR HARDEN, D.Sc., F.R.S.

VITAMIN PROBLEMS.

[Abstract.]

The existence of three vitamins, termed A, B, and C, has now been firmly established, and a general idea has been obtained of their distribution among animal and vegetable organisms. Hitherto, comparatively little quantitative work has been done in this direction, and further progress must depend on a more general adoption of quantitative methods. These are at present tedious and not very accurate. In the case of each of the vitamins the requirements of the special animal employed serve as the unit of comparison, and these vary considerably from individual to individual, so that many observations are necessary if any, even moderate, degree, of accuracy is to be attained. Thus in the estimation of the antiscorbutic potency of food materials, by the method worked out by Miss Chick and her colleagues at the Lister Institute, it has seldom been possible to achieve a greater accuracy than about 25-50 per cent.

This obviously imposes a very serious limitation on any attempts to study variations in potency unless these are of a very gross order. Another great difficulty inherent in this kind of observation is that when the potency is low, the necessary dose of the material to be tested is correspondingly high, and soon transcends what is permissible without interference with other necessary conditions of the diet, such as protein content, etc. Very much the same conditions hold with regard to Vitamin B, especially when this is estimated by the effect of the material on the growth of rats; and, as a matter of fact, the great bulk of the work carried out in America by this method is not strictly quantitative, but simply leads to the result that a certain ration does, or does not, suffice for the growth of a young rat.

As regards Vitamin A, the method of Zilva and Miura promises to yield moderately accurate and consistent results. This is attained by keeping the experimental animals (young rats) on a diet totally deficient in Vitamin A until they have ceased to grow, and then ascertaining the minimum dose of the material to be tested which will induce definite and steady growth for four weeks. Animals which do not cease to grow in three weeks are rejected, greater uniformity in the results being thus attained. The test material is, whenever possible, administered quantitatively to the animal, and not, as was formerly the practice, mixed with the ration in a known proportion. One of the immediate results of the application of this method has been the discovery that cod-liver oil, formerly classed with butter as a good source of Vitamin A, is in reality 200-250 times as potent as butter, and is, along with similar fish-liver oils, by far the richest in this material of all the substances which have so far been examined.

A further piece of information, which is essential for the detailed study of these substances, is their behaviour towards heat, oxidation, etc. In this respect some progress has been made, and it may be stated with some confidence that both Vitamins A and C are moderately stable towards rise of temperature, provided that air be excluded, whereas in the presence of air they are rapidly inactivated. Whether the effect of air is reversible or not has not yet been ascertained. Vitamin B, on the other hand, appears not to be affected by air, and is also moderately stable towards rise of tempera-

ture. None of the three vitamins is easily inactivated by hydrolysis under anaerobic conditions, and this fact has led to the interesting observation that Vitamin A, although usually associated, in the animal organism, with fat, is not itself a fat but remains in the unsaponifiable residue with almost unabated potency. This indicates how small a weight of the vitamin itself is necessary for the daily ration of a young rat. In some cases as little as 1.2 milligram of the oil is sufficient to permit of definite growth, and of this only 1.2 per cent. is unsaponifiable, while, as is well known, the chief constituent of the unsaponifiable matter is cholesterol, which has itself no vitaminic potency. The actual requirement of the vitamin itself must therefore be of the order of 1/500 milligram per diem. The other two vitamins have not been obtained in so concentrated a form, but it appears highly probable that they, too, are present in foodstuffs only in infinitesimal amounts.

The origin of all three vitamins is to be sought in the vegetable kingdom. The production of Vitamin A has been followed (Coward and Drummond) from the seed, and it has been found that it does not appear until the photosynthetic processes begin. Thus sunflower seeds are almost devoid of it, and so are the etiolated seedlings formed when these seeds germinate in the dark. In the light, on the other hand, the green seedlings, grown in a medium free from the vitamin, produce it freely. This vitamin is often closely associated with the carotene and xanthophyll of plants; so intimately indeed, that it was at one time thought that it might be closely related to, if not identical with, one of them. The association, however, although very frequent, is not essential, and no definite relation can be shown to exist between the two. Vitamin C is either absent from seeds or only present in them in very minute amount, but appears when the seed germinates and before any green parts are formed. Nothing is, however, known of the inactive pro-vitamin or of the process by which it is rendered active.

Concerning the origin of Vitamin B, a considerable amount of discussion has taken place. Its presence in a large proportion in yeast points to the probability that it can be produced without the intervention of light, and both in America and in this country it has been found that yeast can actually produce the vitamin when grown in a

"synthetic medium" comprising only substances of known composition and free from the vitamin in question. Recently, however, Eijkman, in Holland, has obtained a contrary result, so that at the moment this remains an open question.

The animal organism appears to be unable, in normal circumstances, to produce any of these principles for itself, and hence the amounts found in animal products depend ultimately on the diet of the animal. This opens up, among many other problems, the important question of the vitaminic properties of milk, and there seems to be no doubt, from experimental work, both here and in America, that these properties are profoundly affected by the diet of the cow. Milk obtained in winter when the animals are stall-fed has been shown to be markedly deficient in Vitamin A, and there is also great danger of a deficiency of Vitamin C. One of the pressing requirements of the moment is the careful quantitative examination of foodstuffs available for the feeding of cattle, so that a rational system of winter feeding can be adopted which will produce milk as good as that given in summer. Such an examination would seem naturally to fall within the purview of the Board of Agriculture.

The evil results of a deficiency of Vitamins B and C, especially in the diet of children, are well known—beri-beri and scurvy, latent or patent—but the effect of a lack of Vitamin A is not so well recognised or so universally acknowledged. One school considers that a deficiency of this vitamin is at least a prominent factor in the causation, if not, as they formerly held, the sole cause of rickets. Others consider rickets to be a disease brought on by non-hygienic surroundings, lack of fresh air and exercise, etc. The latest experimental results show that rickets (in rats) can be produced infallibly by dietetic changes, but that the lack of Vitamin A does not of itself lead to the disease unless at the same time the diet is faulty as regards the supply of calcium or phosphorus. This faulty mineral supply does not usually lead to true rickets if sufficient Vitamin A be present, although the bone formation under these circumstances is not quite normal. This explains the well-known curative effect of cod-liver oil in rickets. So marked is the effect of this remedy, that McCollum, not appreciating the relatively enormous concentration of Vitamin A present in it compared with that in butter, as proved by Zilva, has sug-

gested that cod-liver oil contains some other specific substance absent from butter, to which its great superiority is due. The difference, however, seems to be merely quantitative, and the further complication suggested by McCollum appears to be unnecessary.

These experiments on rickets have led to what promises to be a discovery of far-reaching importance. Rats on a diet, which in the laboratory will infallibly produce rickets, do not acquire the disease if they are exposed to sunlight in the open air or to ultra-violet radiation, and rats which have acquired the disease can be cured by either of these treatments, just as they can be cured by the administration of cod-liver oil. Sunlight and ultra-violet radiation have also been found to be effective cures or preventives of rickets in children. The cures by light and by cod-liver oil seem to proceed in precisely the same way, and the idea naturally suggests itself, especially to the mind of a chemist, that the light actually brings about the synthesis of the vitamin in the animal body just as it does in the plant. This idea still awaits experimental verification or disproof; but there is no doubt that this function of light will lead to profoundly important developments in our knowledge.

[A. H.]

COLLOIDS IN GEOLOGIC PROBLEMS.*

BY GEORGE D. HUBBARD.¹

INTRODUCTION.

It has long been recognised that solid matters occurs in more than two states. The terms "crystalline" and "amorphous" exclude quite a large body of materials, some of which are organic and some inorganic. The other condition has been called the colloidal state. Many substances which occur crystalline can be prepared in the colloidal state without any compositional

* *From the American Journal of Science, August, 1922, p. 95.*

¹ The author is deeply indebted at many points in the paper to Dr. Harry N. Holmes, of Oberlin College, for suggestions and criticism. His *General Chemistry and Colloid Manual* have been of much help also. This paper was presented to the Geologic Section of the Ohio Academy of Science, April 15, 1922.

difference. Amorphous substances were in many instances once in colloidal condition. Perhaps all substances can ultimately be prepared in this state, whether they are normally crystalline or amorphous.

In the case of some substances, there seems to be no line fixed between the crystalline and the colloidal state. In the same way, there seems to be no line which can be definitely drawn between a true solution and a colloidal solution. In practice we say a substance is in the colloidal state when it will not dialyze or diffuse through certain membranes, as egg skin, bladder, goldbeater's skin, or parchment paper. Molecular dispersions are in true solution; dispersions of much larger aggregates (a hundred, more or less, of molecules in one particle) are in colloidal solution. Such particles are too large to pass through the membrane.

Bancroft² says, "Colloid chemistry is the chemistry of grains, drops, bubbles, filaments, and films." Grains of solid particles, drops of fluids, bubbles of gas, filaments very small in two directions, films small only in one direction—these constitute the field of the student of colloids. The smallest particle visible with the aid of the best compound microscope is about 100 millimicrons in diameter, while the largest molecules approach a diameter of 1 millimicron. Materials in the colloidal state have particles ranging between these limits.³

The term "colloid" or "colloidal state" has been expanded to include not only solid gels, but suspensions and emulsions. The former may be solids in liquids, as the very fine sediments in turbid water, liquids in liquids, or even solids in solids, as the blue rock salt which is a suspension of finely divided metallic sodium in crystalline halite. In suspensoids the solid particles do not powerfully absorb or hold large quantities of water. In emulsoids, on the other hand, the particles very powerfully hold or absorb large quantities of water, forming gels. Such gels have been made solid, containing as high as 99.87 per cent. water.

Gels are substances in the colloidal state which have set or become apparently solid, even though they contain a large percentage of water. The fruit juice (acid),

water, and sugar in the jelly cup have set because of a small percentage of pectin. All are essential to the phenomenon. Certain minerals, for example most orthosilicates and some zeolites, on some evaporation after solution in hydrochloric or nitric acid, will set in beautiful gels because of the silicic acid liberated. Sodium silicate or water glass sets in the same way when treated with acetic or some other acid, which makes a salt with the sodium and leaves the silica to gel.

As early as 1861 Thomas Graham⁴ knew that dissolved crystalline substances diffused in and out of silica gels, and that reactions occurred between salts in solution in the gels and solutions from outside which diffused in. The famous Liesegang rings were discovered in 1896. Many of these were rings of metallic crystals or crystalline salts, formed in silica gels by reactions between two solutions, one of which was in the gel and the other was gradually diffusing through the gel. The well-developed crystal had time to form because the solutions came in contact so slowly. Bechhold in 1905, Ziegler in 1906, and Hatschek in 1911 continued experiments with rings in gels.

MINERAL GENESIS THROUGH COLLOIDAL STATE.

Liesegang suggested after his studies on the rings in gels that the banding of agates might be due, in many cases, to the slow diffusion of iron salts through silicic acid gels which had previously been laid in cavities or crevices. He also suggested that this process might explain the formation of large crystals in or on quartz in places where igneous activity had not operated, and where they therefore could not be due to its heat and gases.

In the discussion at the Academy meeting, two points were made. Prof. G. F. Lamb reported orally the finding of good agates in recent clays; the data seem to be wanting as to whether they developed in pre-existing cavities or made their own spaces. Agates in the major cavities of buried bones testify to the recency also of agate-making, and as well to the rate of making. Long ages are not necessary. No evidence was presented as to whether or not the agates came through the gel stage, or how the banding originated.

² Bancroft, W. D., *Applied Colloid Chemistry*, p. 2 (McGraw-Hill Co.).

³ Holmes, H. N., *Colloid Chemistry*, 1922 (Wiley and Sons).

⁴ Hatschek, E., and Simon, A. L., *Trans. Inst. Mining and Metallurgy*, London, 1911-12, XXI., 151-180.

As early as 1884, Clarke tells us, Bourgeois⁵ made opal synthetically from gels of SiO_2 . Clarke⁶ states also that the gelatinous silica formed by the solution of silicates in mineral acids becomes, upon drying, an amorphous mass essentially identical with opal. He also reports that Schafhäütl heated a solution of colloidal silica in a Papin digester and obtained a crystalline deposit of quartz; while de Senarmont heated gelatinous silica with water and carbonic acid gas to temperatures between 200° and 300° C. and obtained a crystalline quartz. Chrustscheff, 1873, obtained quartz from an aqueous solution of colloidal silica by heating to 250° C. for several months. The heat apparently hastened the process, which would have reached the same end in a longer time without so much heat. Silica is dissolved when silicates decompose, and is redeposited by evaporation as opal if still in an acid solution, but when alkalis are present it crystallises.

When the Simplon tunnel in central Switzerland was put through the Alps, the engineers found a vein of silica in the gel condition or colloidal state, thus showing that the silica gel is not purely an artificial product. If the ancient scientists who gave the name "quartz" to rock crystal had found this vein and watched it through its transformation to crystalline quartz, they might have had some ground for their theory that it was made of water which had become so thoroughly frozen in a very cold winter that its solid state had become permanent.

The experiments of Liesegang, and of many other colloid chemists who have followed him, suggest a method for the formation of the quartz-gold vein. They have shown that if a gold solution, e.g., AuCl_3 , is mingled with a silica gel when the latter sets, and then is treated with a reducing agent diffusing through the gel, crystals of gold will form in the gel. Oxalic acid placed on top may serve as this reducing agent. H_2S in water, SO_2 , or CO will serve the same purpose. Sodium sulphite, and especially FeSO_4 , do occur in solutions in nature and would be suitable reducing agents there.

Holmes⁷ has shown that a preparation of silicic acid gel made 0.1N with respect to potassium iodide, and then covered with 0.5N mercuric chloride, gives in the gel after a few days bands of red crystalline mercuric iodide. In some cases as many as 40 rather sharply marked bands occurred in a distance of 8 cm. In a similar manner, bands of copper chromate, cuprous oxide, basic lead iodide, basic mercuric chloride, and other substances were formed. Bands of colloidal gold with scattered crystals of gold developed in a preparation of gold chloride and H_2SO_4 with oxalic acid above the gel.

If the silica gel were in one crevice and an intersecting crevice should be conveying one of these reducing solutions, the conditions of the laboratory would be very nearly duplicated. The only difference would be that the solution need not become continually more dilute, but might remain essentially the same in composition for years. In such case there might be no occasion for the banding of the salts, or if bands developed, they would no doubt be evenly spaced. Banding is explained⁸ as a result of a reduction in concentration of the solution in the gel just in front of the ring, so that the diffusing solution must needs go beyond the clear space to find sufficient concentration for the development of another band. If the flowing solution remain constant in quantity and condition, would not the bands maintain uniform spacing instead of becoming farther and farther apart as in the laboratory experiment?

The laboratory experiment also throws light on the formation of metallic copper in quartz veins. The experimenter used a silica gel dialyzed with acetic acid (sulphuric would have served the same purpose), and mixed with his gel, before it set, a solution of copper sulphate. The reducing agent was placed on top, and the tiny tetrahedrons of metallic copper began to shine in the gel. If the gel was free from aid or any oxidizing agent, the crystals preserved their copper lustre, but without due precautions, they oxidized dark to black. Clusters and chains of tetrahedrons formed as the process continued. After many months this process produced a silica gel vein with appreciable quantities of

⁵ Bourgeois, L., *Production of Minerals artificially*, p. 93 (in French).

⁶ Clarke, F. W., *Data of Geochemistry*, U.S.G.S. Bull., MCXVI., p. 357.

⁷ Holmes, H. N., *Jour. Amer. Chem. Soc.*, 1918, XL., 1187-1195.

⁸ Holmes, *ibid.*

metallic copper disseminated through it. If one wishes to repeat or extend this work, Prof. Holmes⁹ has given full directions for preparing silicic acid gels.

In these cases, all that is necessary to make the typical mineralised quartz vein is to allow the gel to crystallise, a change which has already been explained as a laboratory experiment, and which seems perfectly possible as a natural geologic phenomenon.

Limonite seems to furnish an illustration of an ore once in a colloidal state. There are six hydroxides of iron, made by combining one to six molecules of water with the ferric oxide, only one of which, goethite, is known in the crystalline form. This is the hydroxide with one molecule of water to one of Fe_2O_3 . Clarke, in the "Data of Geochemistry," p. 531, quotes Van Bemmelen as saying that probably no formulae should be given to any of these ferric hydroxides, but rather they should be regarded as polymers of the first, or colloidal, complexes of two or more polymers. Van Bemmelen in a number of papers published between 1888 and 1904 so regards them, and Nicolardot and Spring both consider the several hydroxides polymers of the first. Thus the ferruginous slimes in bogs and around springs, and sometimes in stalactites in caves, as at Mount Taber or Reame's Cave, Ohio, many of which are precipitated by organic agencies, are truly colloids which may in the course of time be dehydrated and pass over into the crystalline goethite, or even into hematite.

Some bauxite was formed by passing through a colloidal state. Colloidal alumina is soluble in water and has been carried some distance before coagulation has taken place. The coagulation is a result of the meeting with electrolytes in solution, whose charge is different from that of the colloid, and therefore the alumina loses its negative charge; the solution first becomes turbid, then the hydroxide actually flocculates and collects into larger and larger lumps, and finally falls to the bottom. Apparently the continued growth of these lumps by the successive addition of layers of aluminium hydroxide builds up the oolitic and pisolitic bodies of typical bauxite. Some bauxite is certainly not of this origin.

These gel ores of iron and aluminium start by decomposition of silicate rocks in the weather zone. Descending waters carry them down into other rocks, or surface waters carry them away to marshes and bogs where the precipitating conditions are found, and the ores are dropped. In the cooler, higher latitudes the iron ores are formed, while the alumina and silica remain together¹⁰; and in the warmer or sub-tropical climates the laterites or bodies of bauxite are formed. Thus the ore deposit may witness to the character of the climate in force when the deposit was made. The precipitation in other rocks would probably take place above the water table; hence in high and dry regions there would be a long vertical range for deposition, which could take place anywhere between the surface and the water table.

It has been pointed out by Kriesch¹¹ that the manganese oxides may also be laid down as gel ores, and subsequently become crystalline. He makes a point also of the fact that this colloidal granular mass of manganese oxides and hydroxides is capable of adsorbing other substances which may permeate it, e.g., barium and potassium compounds. In this way, he accounts for psitomelane, a manganese mineral containing barium and potassium. F. W. Clarke, in his "Data of Geochemistry," p. 533, accepts psitomelane, and some other less known manganese ores, as colloidal complexes. In this connection he also mentions limonite, a capricious hydrate of manganese. The copper may be present simply by adsorption.

The silicate nickel ores have always been a puzzling group, but an interpretation involving colloidal substances seems to simplify the matter. It will be remembered that these ores are hydrous magnesium nickel silicates. The non-metaliferous foundation seems to have accumulated first as a gel,¹² and subsequently to have adsorbed some nickel compound, perhaps nickel silicate, and a magnesium compound, and thus a mixture of two substances occurs which proportions may vary greatly within short distances.

⁹ *Silicic Acid Gels*, L. Comp. Rep., 1901, XXII., p. 401.

¹⁰ Kriesch, *P. Mining and Scientific Press*, 1913, CLXX., 418.

¹¹ Kriesch, *P. loc. cit.*

¹² Holmes, H. N., *Silicic Acid Gels*, Jour. Phys. Chem., 1918, XXII., 510-519.

COAGULATION OR FLOCCULATION OF SEDIMENTS.

It has long been known that even the finest sediments which come out to the sea in the waters of our great rivers fall to the bottom long before they get far into the sea, and that the main body of the ocean is made of comparatively clear water. This speedy precipitation of sediments has also been ascribed to the saltiness of the sea, but the connection had not been worked out until recent studies in colloids and their relations to electrolytes.

An electrolyte is a salt, or in some cases a base or an acid, in water solution through which electric current flows. Salts are generally better electrolytes than acids. The theory is that the electrolyte is ionized, e.g., sodium chloride becomes Na^+ and Cl^- in solution, magnesium chloride becomes Mg^{++} and 2Cl^- in solution. The higher the valence of the base part of the salt (the positive ion), the more powerful the electrolyte, as a coagulant of negatively charged suspensions, and the power seems to bear no definite relation to the valence. Aluminium chloride, for example, is hundreds of times more potent than sodium chloride. The charge on the electrolyte and on the colloid must be of opposite sign. The aluminium ion of $\text{Al}_2(\text{SO}_4)_3$ has a positive charge, and aluminium is trivalent in the sulphate. Since most colloids are negative, aluminium sulphate is one of the most effective flocculators.

These salts are all three in the sea. The sodium chloride makes up fully $3/4$ ths of all the salts there, while the alum constitutes a very small fraction of one per cent., but because of its greater activity, it may be as efficient as the much more abundant sodium chloride. For our purposes, however, it is not material which does the work. A much more important question is, how long have the seas been salt enough to coagulate the fine clays in colloidal suspension as they come down? We have shale rocks made of such clays of all ages back through the Mesozoic, Paleozoic, and perhaps well into the Proterozoic. Such clays, of course, would settle out of quiet waters without the assistance of an electrolyte, but such waters certainly would be difficult to find on the continental shelf. Therefore we may safely assume that these shales made of extremely fine clays were largely precipitated by electrolytes, and that the sea was salt enough in those Proterozoic days to effect their coagulation.

Experiments show that one per cent. sodium chloride solution will coagulate clays rather quickly and that one-tenth per cent. alum solutions will bring them down in a few hours, so we need not assume that the sea had a greater saltiness than, say, 25 per cent. of its present salinity in order to bring down the clays. In this connection it may be interesting to note that the age of the ocean has been calculated on the basis of the NaCl in the water, assuming essentially the same rate of inflow as at present, and only trifling losses as compared with the present salt in the sea. The latter assumption is easily established. The former is probably safe. Dividing the rate by the amount of salt in the sea, Chamberlin and Salisbury arrive at the figure of 370,000,000 years. If anything like one-fourth the present saltiness would be necessary before effective precipitation should take place, then these old shales may be at least 250,000,000 years old, a much larger figure than usually given by geologists for the period since early Proterozoic. On the basis of these figures they may not be more than 300,000,000 years old. Pirsson and Schuchert's geology gives 80-90 instead of 370 million years.

Many colloidal suspensions, like those in the muddy waters of lakes, owe part of their stability to the fact that their particles all carry like charges. Of course, the movements of the waters help to keep the particles up, but in spite of the movements, electrolytes will bring them down, so it seems probable that the electric conditions are as significant in suspensions as is the agitation of the water. If the particles of the colloidal material, and other substances in the solution are similarly charged, the tiny pieces of the colloid do not fall.

Even when waters are allowed to stand as still as they can in a laboratory, some of these colloidal suspensions do not clear up in months. It is believed that the particles are so small that their own Brownian motion prevents them from clinging together into flocculent masses large enough to fall through the water. Stokes' formula gives the following relation:—

$$V = \frac{2r^2g}{9k} \cdot (d - d')$$

V is the velocity of fall of spherical particles of radius r ; k is the viscosity of the fluid; d' and d are the densities of the fluid and the particle respectively, and g the acceleration due to gravity. If water and the

same kind of particles are used on the same table for experiment, the variables all drop out but r .

Theoretically, then, the rate of fall cannot quite be zero, and permanent suspension becomes impossible if the particle is denser than the medium, but practically, since V varies with the square of the radius, we can find particles so small that their fall would be so slow that convection currents and Brownian movement would be ample to keep them up. When two or more coagulate together, their Brownian kicks are proportionately much smaller, and the particle begins to descend. Protecting films of gelatine or other substance which does not mix readily with the medium may surround each suspended particle and prevent its cohering or coalescing with others into masses large enough to fall. Any influence then, Brownian motion, similar electric charge, or protecting films, may help keep the particles small and aid them in staying in suspension.

(To be Continued.)

FEDERAL COUNCIL FOR PURE AND APPLIED CHEMISTRY.*

For many months before his death, Lord Moulton was occupied with the elaboration of a scheme for ensuring the closer co-operation of the various interests—academic and technical, pure and applied—which are embraced by our numerous chemical organisations. Lord Moulton was convinced that a serious defect in the organisation of public affairs in our country lies in the lack of solidarity of sentiment and of expression amongst chemists as a body. The culminating task of his life consisted in unifying the scattered chemical talent of the country, and teaching it to work for the common cause in unison with the engineer and the manufacturer; as Director of the Department of Explosives Supplies, he accomplished this task, but none realised better than he that the extravagant cost of the achievement was largely traceable to the absence of previous organisation amongst chemists. His insight, born of genius and sharpened by experience, told Lord Moulton that the conditions of peace are much like those of war: co-operation saves labour

and treasure, and leads to that efficiency which is essential in a modern economic struggle. He saw the necessity of creating for chemistry a corporate organisation in which all branches of the science and practice should be embraced, which could put forward its collective view with the same force as had long been possible in other learned professions, such as engineering, medicine, and the law.

With this outlook, Lord Moulton threw himself wholeheartedly into the scheme of the Federal Council for Pure and Applied Chemistry, and drafted an appeal for funds in order to rid British Chemistry of certain obvious disadvantages under which it now suffers. He believed that what is needed in this country is a central organisation for chemistry, which should bring under one roof our several important chemical societies, an exhaustive library, ample rooms for administrative purposes and for scientific meetings, and, if possible, the social amenities of a club. There was no thought of injuring the splendid traditions of the Chemical Society and the Society of Chemical Industry; both should retain their autonomy, but if these and other smaller allied societies are to meet modern requirements, there must be that closer co-operation which only comes from physical proximity.

The provision of the needs just above mentioned calls for funds, and in the appeal which Lord Moulton drew up at the end of 1920 he estimated that £250,000 was required for premises, equipment, etc., and a further £250,000 for literary purposes. This appeal was agreed by the Federal Council, and was signed by the Presidents of the sixteen societies then embraced by the Federal Council; it was being placed before prominent personalities in the chemical and manufacturing world for several months previous to the sudden death of Lord Moulton in March of last year.

We have lost our leader; we realise that we cannot hope, in the present condition of the world's financial affairs, to raise £250,000 for our project of placing chemistry in a position similar to that now enjoyed by engineering, medicine, and the law. Pending the better times which we all believe are in store for British industry and British enterprise, we can, however, do much to advance our project. We already have in existence a unifying body. The Federal Council for Chemistry was founded several years ago, with a view to meeting

* From the *Journal of the Society of Chemical Industry*, December 15, 1922.

two generally recognised needs: first, the promotion of co-operation and economy of effort between our several large chemical societies, and, secondly, the representation of those interests of chemical science and technology which are too general in character to be the sole province of either of our existing organisations. Following the example set by the creation of our own Federal Council for Chemistry, many other countries have formed a national Council for Chemistry on very similar lines; all these national councils are now combined under the International Council for Chemistry which was inaugurated at the annual meeting of the Society of Chemical Industry in 1919 (J., 1919, 38, 208T). The International Council now includes the national chemical councils of twenty-four States (J., 1922, 41, 328R); it has held its three previous annual meetings in Brussels, Rome, and Lyons, and is to meet next year in Cambridge.

Hitherto, the International Union for Chemistry has been largely occupied with the organisation of its numerous international interests, such, for instance, as concern the production of international tables of fundamental constants of the elements and the introduction of a generally agreed system of chemical nomenclature; the "Tables annuelles de constantes et données numériques de chimie, de physique et de technologie," edited with such success by Dr. Charles Marie, are published under its auspices. Now that these and related matters of importance have been dealt with, and organisations created which will rapidly increase its productivity, it is intended to extend the scope of the Union and to include in its annual proceedings the presentation and discussion of reports on the progress and development of large scientific and technical questions. This branch of the Union's activities was indeed inaugurated at the recent meeting at Lyons, and the meeting at Cambridge next year will therefore be one of great interest and importance.

Our own Federal Council has taken an active part in the pioneer work of the International Union, although it should be stated that the bulk of the progress made has been due to the devotion of Professor Charles Moureu, its President for the last three years, and our other French colleagues. The Federal Council, in addition, has been able to do a good deal in securing joint action between our large organisations,

such, for example, as promoting the arrangement for some measure of co-operation between the Chemical Society and the Society of Chemical Industry in the weekly publication of the *Journal* of the latter Society. A vast amount remains to be done in this direction, and especially in the establishment of a solid feeling that the chemist should have at heart the interests of his whole subject rather than that merely of the particular chemical society of which he is a member. The promotion of this feeling calls for the united effort of all chemists. It was with this purpose in view that the societies composing the Federal Council were asked to nominate to the Council men who would be active in initiating and carrying into operation measures for the strengthening of the whole chemical organisation of the country.

Hitherto, the principal expenses of the Federal Council have been the annual subscriptions to the International Union, and the revenue has consisted mainly of grants from the Chemical Society and the Society of Chemical Industry. These grants cannot be increased, because both societies have already large calls upon their limited resources for other indispensable purposes; yet money is required to enable the Federal Council to develop its work on an adequate scale. At the meetings of the International Council in Brussels, Rome, and Lyons, the foreign organisations corresponding to our Federal Council entertained the delegates to the Union. We shall have to return the compliment at next year's meeting in Cambridge. Further, whilst the prevailing financial stringency makes it impossible to carry out the large scheme outlined by the late Lord Moulton, it is at least necessary that we should make a beginning. We therefore ask for contributions to be devoted towards the scheme, and so convert into a useful form the sympathy of our chemical colleagues with the objects of the Federal Council.

In the present article we have touched on many questions—and therefore, perhaps, in too scanty detail—and have left unmentioned many others which are also of vital importance to the chemical organism. The nudity of our chemical compendia, the paucity of our efforts to cultivate the social side of chemistry, and so develop the excellent work of the Chemical Industry Club—these and many other matters call for attention: they call for a few chemists to

lead and for many to collaborate, and above all they call for financial support.

With the above considerations in view the Federal Council has appointed a Benefaction Committee, with the request that they will collect funds. The Committee now consists of Sir William Pope, Dr. E. F. Armstrong, Mr. H. E. Coley, Mr. E. V. Evans, Mr. Emile Mond, Mr. W. J. U. Woolcock, and Dr. S. Miall; other names may be added at a later date. It is intended to issue a preliminary list of subscriptions, and when this has been completed to make a widespread appeal in a more or less public manner. It is requested that contributions be sent to Dr. S. Miall, Society of Chemical Industry, Central House, Finsbury Square, London, E.C.

W. J. POPE.

E. F. ARMSTRONG.

H. E. COLEY.

E. V. EVANS.

EMILE MOND.

W. J. U. WOOLCOCK.

STEPHEN MIALL.

FEDERAL COUNCIL FUND.

First List of Contributors.

	£	s.	d.
Dr. E. F. Armstrong, F.R.S.	50	0	0
Sir John Brunner, Bart.	50	0	0
Sir R. Waley Cohen, K.B.E.	50	0	0
E. V. Evans	50	0	0
John Gray	50	0	0
Sir Robert A. Hadfield, Bart., F.R.S.	50	0	0
Dr. J. T. Hewitt, F.R.S.	50	0	0
D. Lloyd Howard	50	0	0
Dr. H. Levisstein	50	0	0
Dr. Stephen Miall	50	0	0
Emile Mond	50	0	0
Robert Mond	50	0	0
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Sir William Pope, K.B.E., F.R.S.	50	0	0
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R. Smith	2	2	0
G. R. Gilks	1	1	0

PROCEEDINGS OF SOCIETIES.

THE CHEMICAL SOCIETY.

ORDINARY SCIENTIFIC MEETING, THURSDAY,
DECEMBER 21ST, AT 8 P.M.

The following paper was read:—

Benzothiazurates, Part II., S. R. H. EDGE.

THE PHYSICAL SOCIETY AND OPTICAL SOCIETY'S ANNUAL EXHIBITION.

This exhibition, which is to be held on Wednesday and Thursday, January 3rd and 4th, 1923, at the Imperial College of Science, South Kensington, will be open in the afternoon (from 3 to 5 p.m.), and in the evening (from 7 to 10 p.m.).

Mr. W. Gamble will give a lecture on "Reproduction of Colour by Photographic Processes," at 4 p.m. on January 3rd, and at 8 p.m. on January 4th. Professor E. C. Coker, F.R.S., will give a lecture on "Recent Photo-Elastic Researches on Engineering Problems," at 8 p.m., on January 3rd, and at 4 p.m. on January 4th. All the lectures will be illustrated by experiments. Over 50 firms are exhibiting scientific apparatus, and a number of experimental demonstrations have been arranged.

We understand that invitations have been given to the Institution of Electrical Engineers, the Institution of Mechanical Engineers, the Chemical Society, the Faraday Society, the Wireless Society of London, and the Röntgen Society. Admission in all cases will be by ticket only, and therefore members of the Societies just mentioned desiring to attend the exhibition should apply to the Secretary of the Society to which they belong. Others interested should apply direct to F. E. Smith, O.B.E., F.R.S. Hon. Secretary of the Physical Society, Admiralty Research Laboratory, Teddington, Middlesex.

ROYAL MICROSCOPICAL SOCIETY.

20, HANOVER SQUARE, LONDON, W.1.

A meeting of the Society was held in the Lecture Hall at the above address on Wednesday, 20th December, 1922, at 7.30 for 8

p.m., when the following papers were read:

MR. JOSEPH E. BARNARD, F.INST.P.,
F.R.M.S., *Sub-Bacteria*.

MR. HUMPHRY J. DENHAM, M.A. (OXON.),
F.R.M.S., *A Micrometric Slide Rule*.

MR. J. R. NORMAN, F.R.M.S., *Methods
and Technique of Reconstruction*.

GEOLOGICAL SOCIETY OF LONDON

The following communications were read:

1. *Geological Investigations in the Falkland Islands*, by HERBERT ARTHUR BAKER, D.Sc., D.I.C., F.G.S.

2. *On a Collection of Fossil Plants from the Falkland Islands*, by ALBERT CHARLES SEWARD, Sc.D., F.R.S., PRES.G.S., and JOHN WALTON, B.A.

GENERAL NOTES.

TRADE FACILITIES AND LOAN GUARANTEE BILL.

The chief purpose of this Bill, which has passed through the House of Commons, is to amend the Trade Facilities Act, 1921, and to extend its scope. The Bill increases from £25,000,000 to £50,000,000 the total amount of loans the principal and interest of which may be guaranteed by the Treasury, and extends the period during which guarantees may be given till 9th November, 1923. Under the original Act the power to give guarantees expired on 9th November last. Guarantees of loans to the amount of £22,243,645 have been given, so that under the new Bill, which permits a total amount of fifty millions, powers will be given to guarantee £27,756,355 of loans in addition to those already made.

Powers are taken in the Bill to charge fees to applicants for guarantees so as to cover the cost of administration.

THE ROCKS OF MOUNT EVEREST.*

The efforts of the members of the Mount Everest expedition of 1922 to reach the summit of the mountain have already been fully given in the public press. That it was found possible to reach an altitude of 27,300 feet, with the aid of oxygen, is sufficiently noteworthy. It is still more interesting that a third expedition is already being tentatively considered, and a greater degree of optimism is felt by the climbers as to ultimate success than after the effort of 1921; this is based practically on the fact that the physiological effects at altitudes of 26,000 and above were found to be less serious than anticipated.

Dr. A. M. Herron has given the results of the examination of rock specimens collected at heights from 23,000 to 27,000 feet. The conclusion is reached that "Mount Everest is a pile of altered sedimentary rocks—shales and limestones—converted into banded hornfels, finely foliated calc-silicate schists, and crystalline limestones. The hornfels and fine schists are in the field blackish or dark green rocks, conspicuously slabby and with a general low dip to the north, which, I believe, adversely and even dangerously affected climbing. The crystalline limestones are fine-grained pure white rocks. The specimens from 23,000 to 25,000 feet show in microscope sections a very fine-grained aggregate of quartz and a greenish mica, with irregular lenticles and veins of chlorite and epidote, and in addition sometimes calcite pyrites and sphene.

"The mountain, from 21,000 to 27,000 feet, is made up of these black and dark green rocks, with occasional beds of white limestone, and veins of quartz and muscovite granite. From 27,000 to 27,500 feet extends an almost horizontal belt, a sill in fact, of schorl muscovite granite, along the whole length of the mountain, which rock presumably, by its superior hardness, gives rise to the prominent shoulder of the mountain north-east of the main peak (shown as 27,390 on Major Wheeler's photographic survey map). Above this again are black schists. Captain Finch informs me that he saw ammonites at a height of about 26,500 feet, but was unable to collect them.

"As to the age of the rocks forming Mount Everest, they may perhaps be assumed, for the present, to be Jurassic or Trias." *London Geological Journal*, September, 1922, pp. 219, 220; see also July,

pp. 67-71, August, pp. 141-144, and October, pp. 288-291, with fifteen beautiful reproductions from photographs.

* From *The American Journal of Science*, November, 1922.

A NEWLY FOUND TENNESSEE METEORIC IRON.*

By G. P. MERRILL (COMMUNICATED).

State Geologist William A. Nelson has forwarded to the U.S. National Museum a mass of meteoric iron recently found by Messrs. C. D. McKnight and M. W. Spencer while working on the roadway leading from Savannah to Cerro Gordo, some four miles north-east of the first-named town in Hardin County, Tennessee. The mass is 18 inches in length, roughly dumb-bell shaped, and weighs 132 lbs. It is an octahedrite in crystallisation and much weathered, undoubtedly representing an old fall. A cast will be made of it, after which it will be cut and analysed, a portion being retained at the National Museum, and a portion returned for the State collection at Nashville.

* From *the American Journal of Science*, November, 1922.

MINOR FAULTING IN THE CAYUGA LAKE REGION.*

By E. T. LONG.

The following corrections should be made in the above article in the number for April (pp. 229-248):—

The first line on p. 232 should read: *The Watkins Glen-Catatonk folio deals with*, etc.

Page 233, line 26 from top, *Enclinal* should read *Encrinal*.

Page 236, line 4 from top, *north* should read *south*.

Page 247, line 18 from top, *Cayuga* should read *Cayuta*.

Page 247, line 23 from top, *Cayuta* should read *Cayuga*.

* From *the American Journal of Science*, November, 1922.

NOTICES OF BOOKS.

The British Journal Photographic Almanac and Photographers' Daily Companion. 1923. Edited by GEORGE E. BROWN, F.I.C. Pp. 808. London: Henry Greenwood & Co., Ltd., 24, Wellington Street, Strand. Price, paper covers 2s., cloth bound 3s. net.

It is pleasing to note that this issue of the *Photographic Almanac* shows signs of an approach to the pre-war issues. The paper upon which it is printed is better than that used for the last few issues.

Naturally, the *Almanac* has been compiled primarily for the use of photographers. For these it contains most valuable information and data, including specific details concerning all the photographic processes.

Perhaps the most important section, and the one which will be of greatest interest to the scientific public, is the *Epitome of Progress*, ably compiled by the Editor himself. It includes a bibliography and full accounts of new apparatus and equipment, methods of photographing various subjects, negative and printing processes, and colour photography. Readers desiring fuller details are referred to the original articles or British abstracts, which are also quoted.

Its utility as a reference volume is enhanced by the inclusion of tables of physical and chemical constants, and also a directory of the photographic trade.

In the preface, the Editor invites suggestions, and it is to be hoped these will be received during the next six months, since later in the year it may be too late to consider new features.

Altogether, the *B.J. Photographic Almanac* maintains its high reputation in the 1923 issue, which will be invaluable to photographers, and particularly to those who have a knowledge of chemistry.

J.G.F.D.

The Origin of Spectra, by PAUL D. FOOTE and F. L. MOBLER. Pp. 250. New York: The Chemical Catalog Co. Inc., 19, East 24th Street. 1922. Price \$4.50.

The experimental aspect of the study of Spectra has hitherto received comparatively little attention, except at the hands of a number of physicists, who have published their results in the various scientific journals.

The subject is recognisedly in a transitional stage, and the theoretical interpen-

tation of the phenomena given by these authors is not intended to be taken as final.

A century ago study and speculation concerning atoms and molecules was conducted by chemists, but a time has come when further knowledge and theoretical deductions in this subject have been obtained by physicists.

This may be due to the regrettable fact that chemists generally do not extend, or sometimes even retain, the mathematical knowledge acquired in collegiate days.

Such will find the reading of this work very difficult.

The authors have compiled their volume from the original papers and the spectral lines and tables obtained by various investigators, amongst whom they themselves can claim to have done a great deal in this subject.

The American Chemical Society is to be congratulated upon publishing such a volume, the utility of which will be very considerable for those investigators interested in this important new subject, but it is to be feared that the main body of chemists will not be able to derive the greatest value from this excellent monograph on account of the limitation alluded to above.

The Theory of Emulsions and Emulsification, by WILLIAM CLAYTON, D.Sc., F.I.C., with a Foreword by PROF. F. G. DONNAN, M.A., Ph.D., D.Sc., F.R.S. Pp. VIII. + 160. London: J. & A. Churchill, 7, Great Marlborough St., W. 1923. Price 9s. 6d.

Whilst there are several well-known volumes which have chronicled the progress in the study of Colloids, none have so far specifically dealt with Emulsions and Emulsification.

The theoretical and industrial importance of emulsions is certainly sufficient to justify the publication of this monograph.

A study of the subject has thrown light upon the problems of surface tension, adsorption, and the Brownian movement, as well as aiding in the elucidation of other problems connected with Colloid Chemistry.

The industrial importance of emulsification will be more fully realised when it is recalled, as Prof. Donnan does in his foreword, that such substances as milk, butter and margarine are emulsions. Various problems connected with lubrication and with the preparation and properties of detergents may be simplified by a more ex-

tensive knowledge of the principles of emulsification.

The author has dealt with the subject from the standpoint of physical chemistry, and the treatment has been very thorough, but in the table on p. 20, *gum mastic* is left in its original German, *Masticharz*, as it appeared in the *Zeitschr. phys. Chem.*, 1912.

This subject, and hence this volume, is of considerable importance, not only to physicists and chemists, but also to many engineers, pharmacists, agriculturists, and others.



THIS list is specially compiled for the *Chemical News*, by Messrs. Rayner & Co., Registered Patent Agents, of 5, Chancery Lane, London, from whom all information relating to Patents, Trade Marks, and Designs, can be obtained gratuitously.

Latest Patent Applications.

- 32954—Carroll, J. C.—Extraction of titanium from ilmenite, etc. Dec. 2.
- 32520—Hirschberg, L. M.—Compositions containing formaldehyde. Nov. 28.
- 32647—Layard, E.—Manufacture of asymmetrical dialkylborbituric acids and products therefrom. Nov. 29.
- 32887—Moore, Q.—Recovery of ammonia. Dec. 1.

Abstract Published this Week.

Ammonium Sulphate.—Patent No. 187035.—Some improvements in the manufacture of Ammonium Sulphate have recently been devised by Messrs. Holme & Co., Ltd. W. G. Whitestone Iron Works, Huddersfield; Adams, W. G. Tar and Ammonia Product Works, Belper; and Cooper, C., Whitestone Iron Works, Huddersfield.

Ammonium sulphate is dried and neutralized in one operation by mechanically conveying the crude salt through a chamber of casing through which flows a current of ammonia gas and heated air in the reverse direction to the salt. The crude salt is fed into a chamber of rectangular cross-section through an opening, and is conveyed by a twin spiral conveyers to the discharge aperture. A casing of thin sheet metal partly surrounds the upper portion of the chamber, and is heated by a gas-burner controlled by a valve. Air is drawn into the chamber through apertures in the casing through which the burner-gases may also pass. Ammonia gas is introduced through the inlet and passes out, together with the heated air, through an aperture, this aperture being connected to a suction device and to apparatus of known type in which the excess ammonia and pyridine, if present, are separated from the residual gases by treatment with acid. Alternatively, the heated air and ammonia may be formed into the chamber under pressure, and the directions of the gas-current and crude salt may be reversed, in which case the chamber is made in the form of a rotary cylinder.

Messrs. Rayner & Co. will obtain printed copies of the published Specifications, and forward on post free for the official price of 1s. each.

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